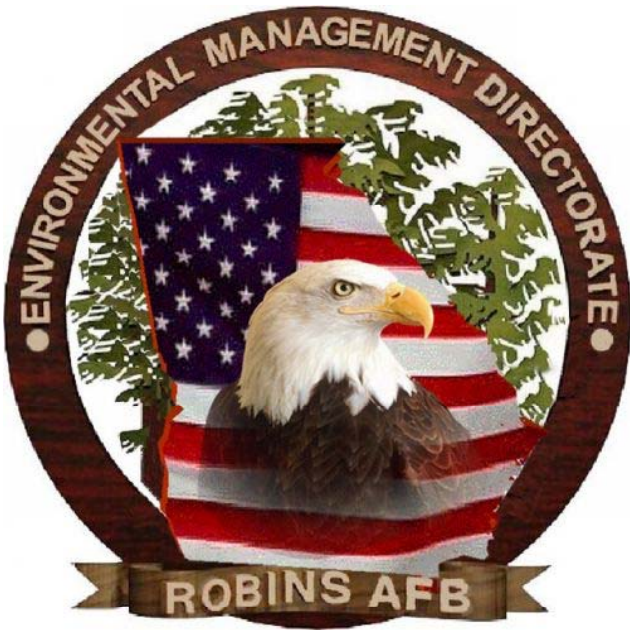


FINAL
RECORD OF DECISION (ROD)
FOR THE NATIONAL PRIORITIES LIST (NPL) SITE, OPERABLE UNITS (OUs) 1 AND 3

Environmental Management Directorate
Robins Air Force Base, Georgia

September 2004

FILE

FINAL

RECORD OF DECISION (ROD) FOR THE NATIONAL PRIORITIES LIST (NPL) SITE, OPERABLE UNITS (OUs) 1 AND 3

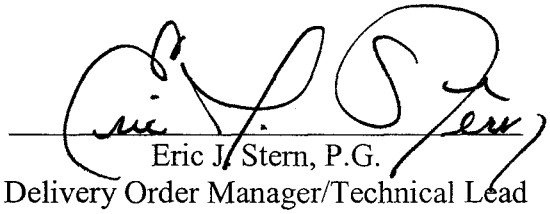
FOR

WARNER ROBINS AIR LOGISTICS CENTER ROBINS AFB, GEORGIA CONTRACT NO. F09650-00-D-0012, DELIVERY ORDER NO. 5055 EARTH TECH PROJECT NO. 75279

Prepared for:
Environmental Management Directorate
Robins Air Force Base, Georgia

Prepared by:
Earth Tech, Inc.

September 2004



Eric J. Stern, P.G.
Delivery Order Manager/Technical Lead

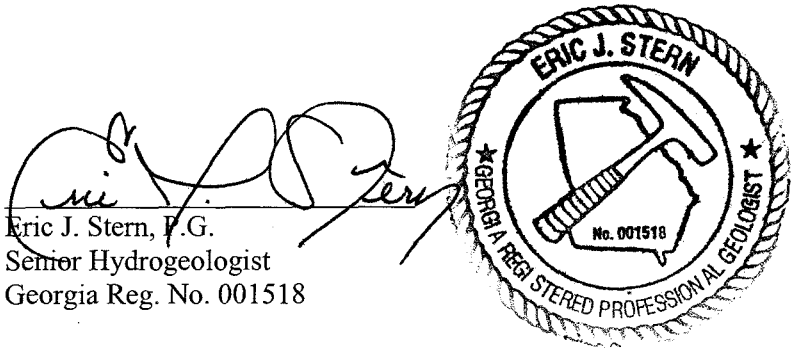
FILE

CERTIFICATION

FINAL
RECORD OF DECISION (ROD) FOR
THE NATIONAL PRIORITIES LIST (NPL) SITE,
OPERABLE UNITS (OUs) 1 AND 3

PREPARED FOR
ENVIRONMENTAL MANAGEMENT DIRECTORATE
WARNER ROBINS AIR LOGISTICS CENTER
ROBINS AIR FORCE BASE, GEORGIA

I certify that I am a qualified groundwater scientist who has received a baccalaureate or post-graduate degree in natural sciences or engineering, and have sufficient training and experience in groundwater hydrogeology and related fields, as demonstrated by state registration and completion of accredited university courses, that enable me to make sound professional judgments regarding groundwater monitoring and contaminant fate and transport. I further certify that this report was prepared by myself or by a subordinate working under my direction.



Eric J. Stern, P.G.
Senior Hydrogeologist
Georgia Reg. No. 001518

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Appendix

LIST OF ACRONYMS

AFB	Air Force Base
ARAR	Applicable Or Relevant And Appropriate Requirement
BEHP	Bis (2-Ethylhexyl) Phthalate
BRA	Baseline Risk Assessment
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation, And Liability Act
COC	Chemicals of Concern
CSM	Conceptual Site Model
EHRAV	Electronic Handbook Of Risk Assessment Values
EPC	Exposure Point Concentration
FFA	Federal Facilities Agreement
GA EPD	Georgia Environmental Protection Division
GPM	Gallons Per Minute
GWTS	Groundwater Treatment System
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Indices
HQ	Hazard Quotient
IRIS	Integrated Risk Information System
IROD	Interim Record of Decision
IRP	Installation Restoration Program
ISA	Initial Screening of Alternatives
IWTP	Industrial Waste Treatment Plant
LF04	Landfill Number 4
LUC	Land Use Control
MCL	Maximum Contaminant Level
MNA	Monitored Natural Attenuation
NAPL	Non-Aqueous Phase Liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
O&M	Operations and Maintenance
OU	Operable Unit
PAH	Polynuclear Aromatic Hydrocarbon
PP	Proposed Plan
RAO	Remedial Action Objective
RCRA	Resource Conservation And Recovery Act
RFD	Reference Dose
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SF	Slope Factor
SHRTSC-NCEA	Superfund Health Risk Technical Support Center National Center For Environmental Assessment
SPHEM	Superfund Public Health Evaluation Manual
SVE	Soil Vapor Extraction
TCE	Trichloroethene
USAF	United States Air Force

LIST OF ACRONYMS (Continued)

US EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WQS	Water Quality Standard

1.0 DECLARATION FOR THE RECORD OF DECISION

1.1 SITE NAME AND LOCATION

National Priorities List Site (NPL Site) (formerly referred to as Zone 1), Robins Air Force Base (AFB)
Operable Unit 1 (OU1) – Landfill No. 4 (LF04) and the WP14 Sludge Lagoon (Sludge Lagoon) Source Units
Operable Unit 3 (OU3) – Groundwater contaminated by OU1
Warner Robins, Houston County, Georgia
National Superfund Identification Number: GA1570024330
Robins AFB is located approximately 18 miles south of Macon, Georgia.

1.2 STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) is being issued by the United States Air Force (USAF), which is the lead agency for remedial activities at Robins AFB. The remedy was selected by the USAF in conjunction with the United States Environmental Protection Agency (US EPA) – Region IV with the concurrence of the Georgia Environmental Protection Division (GA EPD).

This ROD presents the selected remedial action for addressing the NPL Site OUs 1 and 3 of the Robins AFB Site, developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act, and to the extent practicable, the *National Oil and Hazardous Substances Pollution Contingency Plan* (NCP) (US EPA, 1990b). This decision is based on the Administrative Record file for this site.

1.3 ASSESSMENT OF SITE

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. Figure 1 presents a site location map that shows the LF04 and Sludge Lagoon source unit areas at the NPL Site in relation to Robins AFB.

1.4 DESCRIPTION OF THE SELECTED REMEDY

The remedial action objectives at this NPL site were to (1) perform Interim Actions at OU1 to mitigate impact to groundwater; (2) perform an Interim Action for groundwater (OU3) that provided for containment of contaminated groundwater and prevented further migration, and (3) perform a final action for OUs 1 and 3.

The source material (OU1) has undergone several physical and chemical treatments in order to reduce the principal threats. The sludge lagoon underwent volatilization and solidification to immobilize the principal threat wastes. The rest of the landfill waste mass was not treated due to costs and the uncertainty of contents. Land use controls (LUCs) are necessary for OU1 since containment and not treatment was selected as the remedy. For OU3 groundwater, there are no principal threat wastes.

1.4.1 Selected Remedy For Operable Unit 1

The Selected Remedy for OU1 (LF04 and the Sludge Lagoon) as described in the Interim Record of Decision (IROD) (Installation Restoration Program (IRP), 1991) and the Feasibility Study (FS) (Earth Tech/Rust E&I, 1999a) includes the following actions that have already been completed:

- Initial clay capping of the Sludge Lagoon with a clayey sand cover;
- In situ volatilization of the Sludge Lagoon waste mass;
- Excavation of the Sludge Lagoon waste mass and solidification;
- LF04 cover renovation using geosynthetic fabric and clay liner;
- Installation of gas collection system at LF04;
- Construction of a new cover over LF04 and the Sludge Lagoon;
- Construction of a run-on diversion structure around LF04;
- Installation of a groundwater extraction system at LF04;
- Installation of a leachate collection system at LF04; and
- Institutional controls for access to site.

Since the exposure pathways to the waste materials in OU1 have been eliminated, and further groundwater impact to OU3 (groundwater) has been mitigated, no additional remedial actions will be undertaken. This decision has been approved by the agencies in the Initial Screening of Alternatives (ISA) document, which recommends no further action for OU1 (Robins AFB, 1998). The final remedy

for OU1 is containment through maintenance of the cap as well as LUCs limiting site use and activity. As the lead agency, Robins AFB will be responsible for implementing and enforcing all institutional controls/LUCs.

1.4.2 Selected Remedy for Operable Unit 3

The Selected Remedy for the OU3 (groundwater) includes the following:

- Optimization of the current OU3 Interim Action groundwater extraction system by evaluating the efficiency and effectiveness of the OU3 groundwater extraction system. When the evaluation of the data for two groundwater sampling events indicate that the continued operation of the system is less efficient and effective than monitored natural attenuation (MNA), documentation will be provided by the Air Force to the US EPA and GA EPD to justify the technical decision for turning off the groundwater extraction system and transitioning to MNA. The supporting data may include the analytical results, isoconcentration maps, contaminant trend analyses, groundwater extraction rate data, contaminant mass removal data, system operating costs, and revised groundwater and transport modeling, as applicable. The supporting data will sufficiently document the groundwater treatment system's efficiency and effectiveness. This evaluation, subject to the US EPA and GA EPD review and approval, will allow for deactivating the OU3 groundwater extraction system and transitioning to MNA when it is determined that MNA is the most appropriate remedial strategy;
- Treatment of the extracted groundwater in the Groundwater Treatment System (GWTS);
- Discharge the treated groundwater (effluent) to the Ocmulgee River at a preexisting National Pollution Discharge Elimination System (NPDES) permitted outfall, in accordance with the substantive standards under that permit;
- Annual monitoring to verify the reduction in contaminant concentrations and to monitor the effectiveness of natural attenuation mechanisms; and
- Limiting the future use of the site (land and groundwater) through institutional controls/LUCs.

As the lead agency, Robins AFB will be responsible for implementing and enforcing all institutional controls/LUCs.

1.5 STATUTORY DETERMINATIONS

The remedies for OU1 and OU3 are protective of human health and the environment, comply with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, are cost-effective, and utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. Although treatment has occurred in select source areas (Sludge Lagoon) of LF04, the OU1 remedy does not attain the statutory preference for treatment as a principal element of the remedy because there is no cost-effective treatment technology for a 45-acre landfill. However, the remedy selected involves containment of the source area, which is the US EPA presumptive remedy for landfills. The remedy for OU3 satisfies the statutory preference for treatment as a principal element of the remedy that permanently and significantly reduces the toxicity, mobility, and volume of hazardous substances, pollutants, or contaminants.

Because the remedies for OU1 and OU3 will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted no less often than every five years after initiation of remedial action under this ROD to ensure that the remedy continues to be protective of human health and the environment.

1.6 DATA CERTIFICATION CHECKLIST

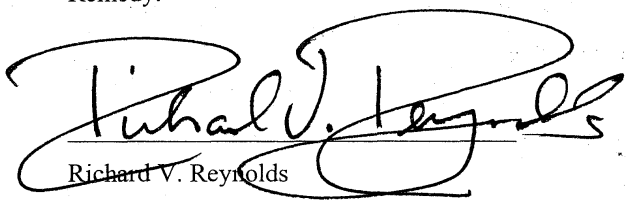
The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file at Robins AFB for the NPL Site.

- Chemicals of concern (COCs) and their respective concentrations (see starting on page 15 [Section 2.5.6] and Tables 1, 2, and 3).
- COCs in the baseline risk assessments (BRAs) (see starting on page 21 [Section 2.7.2.1.2] and Table 4).
- Baseline risk level represented by the COCs (see starting on pages 19 and 20 [Sections 2.7.1 and 2.7.2], starting on page 29 [Section 2.7.2.3], and Table 9).
- Cleanup levels established for COCs and the basis for these levels (see starting on page 29 [Section 2.7.2.3] and Table 2).
- How source materials constituting principal threats are addressed (see starting on page 40 [Section 2.11]).

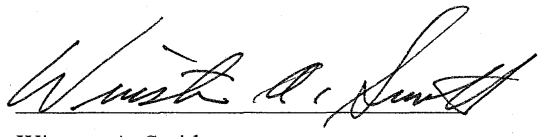
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the BRA and ROD (see starting on page 18 [Section 2.6], starting on page 21 [Section 2.7.2.1.2], and Table 11).
- Potential land and groundwater use that will be available at the NPL Site as a result of the Selected Remedy (see starting on page 47 [Section 2.12.5]).
- Estimated capital, annual operations and maintenance (O&M), escalated costs, present worth costs, and the number of years over which the remedy cost estimates are projected (see starting on page 46 [Section 2.12.4] and Tables 11 and 12).
- Key factor(s) that led to selecting the remedy (see starting on page 44 [Section 2.12.2] and Tables 11, 13, and 14).

1.7 AUTHORIZING SIGNATURES AND SUPPORT AGENCY ACCEPTANCE OF REMEDY

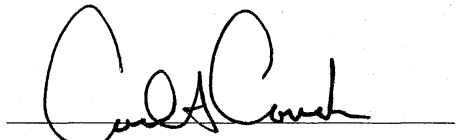
The following signatures below signify that all parties agree to the contents of this ROD and the Selected Remedy.



Richard V. Reynolds
Lieutenant General, USAF
Vice Commander, Air Force Materiel Command



Winston A. Smith
Director, Waste Management Division
United States Environmental Protection Agency



Carol A. Couch, Ph.D.
Director
Georgia Environmental Protection Division

2.0 THE DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND DESCRIPTION

- Name and Location: NPL Site, Robins AFB
  OU1, LF04 and the Sludge Lagoon Source Units
  OU3, Groundwater Contaminated by OU1
  Warner Robins, Houston County, Georgia
- National Superfund Identification Number: GA1570024330
- Lead and Support Agencies: Lead: USAF, Support: US EPA and GA EPD.
- Source of Cleanup Monies: The funding for cleanup of the NPL Site is the Air Force Environmental Restoration Account, which are monies designated by the United States Congress specifically for the IRP.
- Site Type: Landfill
- Site Description: The NPL Site at Robins AFB consists of two IRP sites. The two IRP sites are LF04 and the Sludge Lagoon. The LF04 source unit (OU1) is a 45-acre landfill. The Sludge Lagoon source unit (OU1) was a 1.5-acre unlined lagoon (Figure 2). The NPL Site was initially divided into three OUs. OU1 is defined as the LF04 and the Sludge Lagoon source units. OU3 is defined as the groundwater contaminated by OU1 (the LF04 and the Sludge Lagoon source units). In 2003, the US EPA, the GA EPD, and Robins AFB agreed that the adjacent wetlands area, formerly known as OU2, did not contain contamination from the LF04 and the Sludge Lagoon source units (OU1) and, therefore, would not be addressed under the current Federal Facilities Agreement (FFA) (US EPA, 2003b). The former OU2 wetlands area is being addressed under the Resource Conservation and Recovery Act (RCRA) delegated to the State of Georgia. Therefore, this ROD addresses only OU1 and OU3.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.2.1 Activities That Have Led to Current Problems

Robins AFB has generated various types of solid wastes over the years of operation, including refuse and hazardous wastes. The LF04 source unit was operated from 1965 to 1978 for disposal of general refuse and industrial wastes (Figure 2). The Sludge Lagoon source unit was used from 1962 to 1978 for disposal of IWTP sludges (Figure 2). Sludge from the IWTPs contained phenols, oils, and other wastes. Electroplating sludge from IWTP No. 2 contained heavy metals and cyanide. Miscellaneous industrial

wastes, such as solvents, cleaners, paint removers, hydraulic fluids, and oils, were also placed in the lagoon. The Sludge Lagoon was closed in 1978 by capping with a clayey sand cover approximately five feet thick.

2.2.2 Federal, State, and Local Site Investigations and Remedial Actions Conducted to Date Under CERCLA and Under Other Environmental Authorities

Following a survey of the Base in 1982, former disposal areas were grouped into eight zones that were based primarily on location and type of disposal activity. The NPL Site (formerly referred to as Zone 1), which includes the LF04 and the Sludge Lagoon sources units (OU1), was considered to have the highest potential for migration of hazardous substances and, as a result, was placed on the CERCLA NPL by the US EPA in 1987. Soils in LF04 and the Sludge Lagoon were found to contain constituents at concentrations sufficient to leach to the groundwater at levels higher than the maximum contaminant level (MCLs). Due to this impact, Interim Actions were conducted for OU1 and OU3.

In August 1996, Robins AFB completed remediation of the Sludge Lagoon as an Interim Action where the waste mass was first treated by in-situ volatilization then excavated and solidified. In addition, a geosynthetic fabric and clay liner were installed over the entire surface area of OU1 (LF04 and the Sludge Lagoon).

In September 1998, a soil cover renovation was completed for LF04. The renovated soil cover installed over LF04 also extends over the Sludge Lagoon. The design of the landfill cover complied with the cover requirements of the IROD and consists of the following (Figure 3) (Environmental Chemical Corporation, 1997):

- Site grading soil
- Gas collection system
- Geosynthetic clay liner
- Drainage layer system
- Topsoil

The remedial action objectives (RAOs) for OU3 (groundwater) are containment and remediation of contaminants to the MCLs as defined in Table 2 of this ROD. As part of the Interim Action at LF04, six groundwater recovery wells (RW1 through RW6) were installed along the northeastern boundary of LF04

and the Sludge Lagoon (Figure 4). The Interim Action also included the construction and operation of a groundwater treatment plant. The treated groundwater ultimately discharges to the Olcmulgee River basin under a preexisting NPDES permit. The recovery wells have operated in order to capture elevated levels of contaminants while allowing residual contaminants, not feasibly captured by the OU3 groundwater extraction system, to be reduced by natural attenuation. Due to lack of detected contamination in recovery well RW1, the operation of this well was discontinued in February 1999 with prior regulatory approval (US EPA and GA EPD). The decision to deactivate the recovery well was approved by the GA EPD in an e-mail forwarded on 10 February 1999 and by the US EPA verbally at the NPL Site meeting held on 10 February 1999.

Groundwater modeling was performed to determine the optimum flow rate and location of the extraction wells as described in the Feasibility Study (Earth Tech/Rust Environment & Infrastructure, 1999a). During the NPL Site Team Meeting held on 10 January 2002, the US EPA and the GA EPD confirmed that Robins AFB could proceed with implementation of the Draft ROD (Earth Tech, 2000a). Operation of recovery wells RW2, RW3, and RW6 was discontinued on 14 May 2002 in accordance with the OU1 and OU3 Draft ROD. As part of the agreement, larger pumps were placed in both recovery wells RW4 and RW5 to increase the rate of withdrawal from approximately 30 gallons per minute (gpm) to 50 gpm. These recovery wells are currently rehabilitated periodically to ensure optimum performance of the system.

Robins AFB has initiated a number of corrective measures at the NPL Site to limit or mitigate the impacts to OU3 (groundwater) including the construction of a run-on diversion structure around LF04 and the installation of a leachate collection system around the northern periphery of LF04, which began operation in October 1997. The leachate collection system is referred to as the "LF04 toe drain." There are four leachate pump stations within the LF04 toe drain. One of the pump stations, LF4PS3, was shut down as approved by the US EPA and the GA EPD at the monthly NPL Site meeting held on 17 March 1999. The three remaining pump stations (LF4PS1, LF4PS2, and LF4PS4) operated until 14 May 2002 and were subsequently shut down, thereby decommissioning the LF04 toe drain, in accordance with the OU1 and OU3 Draft ROD (Earth Tech, 2000a).

2.2.3 History of Comprehensive Environmental Response, Compensation, and Liability Act Enforcement Activities

The US EPA placed the site on the CERCLA NPL in 1987 (National Superfund Identification Number: GA1570024330). In June 1989, Robins AFB entered into a FFA with the US EPA and the GA EPD to establish a procedural framework and a schedule for developing, implementing, and monitoring appropriate response actions at the NPL Site in accordance with CERCLA, the NCP, Superfund guidance and policy, and the Georgia Hazardous Waste Management Act.

From 1991 to 1994, there were several disputes concerning the applicable or relevant and appropriate requirements (ARARs) for OU3 (groundwater) at the NPL Site. These disputes eventually led to the February 28, 1994, Dispute Resolution of ISA for OU3. The ISA dispute resolution resulted in defining the groundwater point of compliance as Hannah Road (Figure 1), and the interim remedial goals as US EPA MCLs and nonzero maximum contaminant level goals for the Blufftown and Providence aquifers and as Georgia Ambient Water Quality Criteria for the Quaternary alluvial aquifer.

In 2003, the US EPA, the GA EPD, and Robins AFB agreed that the adjacent wetlands area, formerly known as OU2, did not contain contamination from the LF04 and the Sludge Lagoon source units (OU1) and, therefore, would not be addressed under the current FFA (US EPA, 2003b). The former OU2 wetlands area is now being addressed under the RCRA regulations delegated to the State of Georgia.

2.3 COMMUNITY PARTICIPATION

The Remedial Investigation/Feasibility Study (RI/FS) Report and Proposed Plan (PP) for OU1 and OU3, Robins AFB, Georgia, were made available to the public in January 2000 (Earth Tech/Rust E&I, 1999a and Earth Tech/Rust E&I, 1999b, respectively). These unabridged documents are part of the FFA Administrative Record File, which is available for review by the public at the following location:

Warner Robins Air Logistics Center Environmental Management Directorate (WR-ALC/EM)
455 Byron Street, Suite 465
Robins AFB, Georgia 31098-1646
(478) 926-1197

Selected "final" documents including the RI/FS and PP are available through the repository listed below:

Nola Brantley Memorial Library
721 Watson Boulevard
Warner Robins, Georgia
(478) 923-0128

A public comment period was held from January 23 to March 24, 2000, following the issuance of the PP on January 23, 2000. The public was notified of the PP and the 45-day public comment period through mailing of the Robins AFB newsletter (*The Rev Up*) and through the *Warner Robins Sun* and *Macon Telegraph* newspapers. A public meeting was held on February 10, 2000, to present the PP to a broader community audience than those that had already been involved at the NPL Site. At this meeting, representatives from the US EPA and the GA EPD answered questions concerning the remedial alternatives. This meeting was also used to solicit a wider cross-section of community input on any issues associated with the NPL Site. Response to the comments received during this period is included in the Responsiveness Summary (Section 3.0), which is part of this ROD. There have been no significant changes to the recommended remedy; therefore, no additional public comment period is necessary.

2.4 SCOPE AND ROLE OF OPERABLE UNIT

As with many Superfund sites, the problems at the NPL Site are complex. As a result, work was initially organized into three OUs:

- OU1: The LF04 and the Sludge Lagoon source units;
- OU2: The wetlands being addressed under the RCRA regulations delegated to the State of Georgia (GA EPD); and
- OU3: The groundwater contaminated by the LF04 and the Sludge Lagoon source units.

The subjects of this ROD are OU1 and OU3. The overall site cleanup plan is provided below. Please note that many components of the cleanup plan have already been completed in conformance with the OU1 and OU3 IRODS (IRP, 1991 and 1995b, respectively).

Operable Unit 1 Past Response:

As specified in the OU1 IROD (IRP, 1991), the past Interim Action remedial responses have been performed in the presented sequence:

- In situ volatilization of the Sludge Lagoon waste mass;
- Excavation of the Sludge Lagoon waste mass and solidification;
- Renovation of the initial LF04 clayey sand cover using geosynthetic fabric and a clay liner (See Figure 3);
- Installation of gas collection system at LF04;
- Construction of a new cover over LF04 and the Sludge Lagoon (See Figure 3);
- Construction of a run-on diversion structure around LF04;
- Installation of a groundwater extraction system at the Sludge Lagoon concurrent with the groundwater extraction system installed at LF04 (See Figure 4); and
- Installation of a leachate collection system at LF04 (See Figure 4).

Operable Unit 1 Activities Proposed in This ROD:

- Institutional controls/LUCs for access to the NPL Site and future land use;
- Statutory reviews no less often than every five years after the initiation of the remedial action presented under this ROD; and
- No further action regarding the OU1 Interim Actions as described in the IROD.

Operable Unit 3 Past Response:

As described in the OU3 IROD (IRP, 1995b), the past Interim Action remedial responses have been performed in the presented sequence

- Installation of a the OU3 Interim Action groundwater extraction system at LF04 (See Figure 4);
- Installation of a GWTS for treatment of the extracted groundwater from LF04 (See Figure 4);
- Discharge of the treated groundwater (effluent) to the Ocmulgee River to a preexisting NPDES permitted outfall; and
- Perform annual groundwater monitoring to verify the reduction in contaminant concentrations.

Operable Unit 3 Activities Proposed in This ROD:

- Optimization of the current OU3 Interim Action groundwater extraction system by evaluating the efficiency and effectiveness of the OU3 groundwater extraction system. When the evaluation of

the data for two groundwater sampling events indicate that the continued operation of the system is less efficient and effective than MNA, documentation will be provided by the Air Force to the US EPA and GA EPD to justify the technical decision for turning off the groundwater extraction system and transitioning to MNA. The supporting data may include the analytical results, isoconcentration maps, contaminant trend analyses, groundwater extraction rate data, contaminant mass removal data, system operating costs, and revised groundwater and transport modeling, as applicable. The supporting data will sufficiently document the groundwater treatment system's efficiency and effectiveness. This evaluation, subject to the US EPA and GA EPD review and approval, will allow for deactivating the OU3 groundwater extraction system and transitioning to MNA when it is determined that MNA is the most appropriate remedial strategy;

- Perform annual monitoring to verify the reduction in contaminant concentrations and to assess the effectiveness of natural attenuation;
- Implementation of institutional controls/LUCs for access to the site (land and groundwater) and future land use; and
- Statutory reviews no less often than every five years after the initiation of the remedial action presented under this ROD.

The overall cleanup strategy is containment of OU1 and remediation of OU3 to MCLs. The strategy for OU3 was to remediate the groundwater through a network of extraction wells and treat the contaminated groundwater prior to discharging in accordance with a preexisting NPDES permit. Ingestion of groundwater extracted from OU3 may pose a risk to human health because the US EPA's acceptable risk range of 10^{-4} to 10^{-6} is exceeded and concentrations of the COCs were greater than the MCLs for drinking water (as specified in the Safe Drinking Water Act) (See Tables 1 and 2). Current available data supplied from the Spring 2003 basewide sampling event (Table 3) indicate that the maximum concentrations of several of the COCs are now below MCLs (Earth Tech, 2003). To address the remaining contamination in OU3, optimization of the groundwater extraction system will be performed by increasing or decreasing the number of wells and flow rate of the groundwater extraction network based upon the evaluation of the efficiency and effectiveness of the OU3 groundwater extraction system. This evaluation, subject to US EPA and GA EPD review and approval, will allow for deactivating the OU3 groundwater extraction system and transitioning to MNA when it is determined that MNA is the most appropriate remedial strategy.

2.5 SITE CHARACTERISTICS

The following subsections present a brief but comprehensive overview of the NPL Site.

2.5.1 Conceptual Site Model

As part of the RI/FS, a site-specific conceptual site model (CSM) was developed to support the BRA as well as the response action for this NPL Site. The CSM was based on the waste sources, pathways, and receptors potentially present prior to interim remedial actions that have been implemented at the site. The CSM is presented graphically in Figure 5. It depicts known and suspected historical sources of contamination (LF04 and the Sludge Lagoon), the source medium (soil) initially contaminated by the wastes at LF04 and the Sludge Lagoon, release mechanisms by which contaminants migrated from the source medium to groundwater, exposure media, exposure routes, and human and ecological receptors that potentially could have been exposed to contaminants at the NPL Site under baseline conditions (i.e., in the absence of any remedial actions). The diagram shows that the source medium (OU1) impacted groundwater (OU3) via infiltration/leaching.

In the CSM diagram (Figure 5), the potentially complete pathways are indicated by an "x" in the corresponding box representing an exposed receptor. Either an empty box or a box with an "x^3" and an explanatory footnote associated with it indicates incomplete pathways for each receptor. Under the current land use scenario evaluated at the time the BRA was performed (i.e. industrial landfill near a residential area and accessible to trespassers and recreators), it was assumed that human receptors potentially exposed to contaminants in site media included both on-site and off-site trespassers/recreators and off-site residents. Under the future land use scenario evaluated at the time the BRA was performed, it was also assumed that if site-related contaminants were transported off-site, both human receptors (e.g., hypothetical residents) and ecological receptors (e.g., wetland biota) might be exposed in the downgradient wetlands. Potentially complete exposure routes identified included ingestion, dermal contact, and inhalation (dust and vapors) of soil contaminants (OU1); ingestion, dermal contact, and inhalation (water vapors) of groundwater contaminants (OU3), assuming potential use of on-site groundwater as potable water supply; ingestion and dermal contact with surface water and sediment contaminants; and ingestion of wetland contaminants via the aquatic food chain. These potentially complete pathways were addressed in more detail in the RI and BRA reports for this site (CH2M Hill, 1990; CH2M Hill, 1993; CDM, 1992; CDM, 1995; and CDM, 1996), and are summarized in Section 2.7 of this report.

2.5.2 Site Overview

The NPL Site is located adjacent to a bluff that forms the western boundary of the Ocmulgee River flood plain. The Ocmulgee River flood plain extends about one to two miles eastward to the Ocmulgee River. The NPL Site consists of two past source area OUs: LF04 and the Sludge Lagoon (OU1) and the groundwater (OU3) contaminated from OU1. LF04 is a 45-acre landfill operated from 1965 to 1978 for disposal of general refuse and industrial wastes, and the Sludge Lagoon was a 1.5-acre unlined lagoon used from 1962 to 1978 for disposal of IWTP sludges. The source of groundwater (OU3) contamination has been through exposure and leaching of contamination from the LF04 source unit.

2.5.3 Surface and Subsurface Features

The NPL Site consists of LF04 and the Sludge Lagoon. There are no other surface or subsurface features.

2.5.4 Sampling Strategy

The sampling strategy conducted and completed during the RI in 1989 was to collect samples from all media (soils, groundwater, surface water, and sediments) in the vicinity of the NPL Site. Because this ROD is focused only on OU1 (LF04 and the Sludge Lagoon) and OU3 (groundwater), the sediment and surface water sampling and results are not presented in this ROD. The sample results from the RI phase dictated many of the interim actions that were completed such as the solidification of the Sludge Lagoon. Most of the sampling completed since 1989 for OU1 and OU3 has focused on groundwater quality. The Robins AFB basewide sampling program was conducted semiannually in 1991 and 1993 through 1995 and annually from 1996 through 2003. The most recent basewide sampling program report and annual operational progress report for LF04 provide current data and both historical and concentration trend data for OU3 (Earth Tech, 2003, 2004a, 2004b, 2004c, and 2004d, respectively). In addition, the annual progress report (Earth Tech, 2004d) provides an evaluation of the effectiveness of the OU3 groundwater extraction system.

2.5.5 Sources of Contamination

The two IRP sites are LF04 and the Sludge Lagoon. LF04 is a 45-acre landfill operated from 1965 to 1978 for disposal of general refuse and industrial wastes. The Sludge lagoon was a 1.5-acre unlined lagoon used from 1962 to 1978 for disposal of IWTP sludges (Figure 2).

2.5.6 Type of Contamination and Affected Media

The media of concern at the NPL Site include soils/waste materials of LF04 and the Sludge Lagoon (OU1) and groundwater (OU3) that has been impacted by OU1. This subsection describes the nature and extent of contamination present in the OU1 waste mass and OU3 groundwater. The RI and FS for the NPL Site provide greater detail identifying environmental samples of all media collected at the NPL Site (CH2M Hill, 1990; CDM, 1992; CH2M Hill, 1993; Earth Tech/Rust E&I, 1999a). The Semi-Annual and Annual Progress Reports for the years 1998 through 2003 provide details of the environmental sampling and performance of the remedial system since operation of the groundwater extraction system was installed in 1998 (Rust E&I, 1998b; Rust E&I, 1998c; Rust E&I, 1999, Earth Tech/Rust E&I, 1999c; Earth Tech/Rust E&I, 1999d; Earth Tech/Rust E&I, 2000a; Earth Tech, 2000b; Earth Tech, 2001a; Earth Tech, 2001b; Earth Tech, 2004a; Earth Tech, 2004b; and Earth Tech, 2004c;). The basewide groundwater sampling reports for Robins AFB provide current data and both historical and concentration trend data for OU3 (Earth Tech, 2003).

Table 1 includes a listing of the most prevalent chemicals that were detected in the source area (OU1) during the RI performed in 1991. The most prevalent metals contamination observed included lead, chromium, cadmium, mercury, and arsenic. Organic contaminants found most often in the landfill leachate included: benzene, toluene, and chlorinated compounds, methylene chloride, trichloroethene (TCE), and 1,2-dichloroethene. The contaminants most often found in the leachate were also found in the Sludge Lagoon leachate. However, for most contaminants, concentrations were higher in samples collected and analyzed from the Sludge Lagoon area.

Table 2 presents the COCs for OU3 (groundwater) as generally reported in the 1999 FS (Earth Tech/Rust E&I, 1999a). It should be noted that the FS completed in 1999 was based on a list of COCs derived from data collected and analyzed during the 1998 basewide sampling event, while the BRA completed in 1993 was based on data collected in 1989. In addition, a recent analysis of data collected during the annual basewide groundwater sampling programs from the period of 1999 through 2003 has indicated that two inorganic contaminants (nickel in the surficial aquifer and chromium in the Quaternary alluvial aquifer) should no longer be considered as COCs (Appendix A). The list of COCs developed in the 1999 FS differs from those developed in the 1989 BRA. Section 2.7 of this ROD includes analytical data from both 1989 and 1999. A CSM on which the risk assessment and response action are based is presented as Figure 5.

The quantity and volume of waste has not been calculated in previous reports but has been estimated for this ROD. The volume of waste mass identified as OU1 is approximately 900,000 tons of soils and saturated soils, while the volume of contaminated groundwater associated with OU3 is approximately 76 million gallons.

Figure 6 provides a generalized depiction of the hydrogeologic conditions at the NPL Site. Historical plume maps for TCE and lead from 1989 and other annual sampling events are presented in Figures 7 through 22. Based upon the results of the COC identification for the 1999 FS report, no remedial alternatives will be developed for both the lower Providence unit within the Providence aquifer and the Blufftown aquifer since they do not contain COCs. The lower Providence unit within the Providence aquifer and the Blufftown aquifer are, however, addressed in relation to potential future impacts by the COCs. Since 1998, when the OU3 groundwater extraction system was installed and operated, the COCs have been steadily declining (Figures 7 through 17). The 2003 data from recovery wells RW4 and RW5 groundwater samples indicate that TCE concentrations are rapidly approaching cleanup levels. In addition, it appears that the concentrations of lead are also exhibiting decreasing trends (Figures 18 through 22), likely attributable to natural attenuation mechanisms (i.e. dispersion, dilution, and adsorption).

2.5.7 Location of Contamination and Potential Routes of Migration

Contaminants associated with groundwater in the surficial aquifer, the Quaternary alluvial aquifer, and the upper Providence unit may migrate and discharge to the wetlands neighboring LF04. However, migration of any of the contaminants through Layer 1 (surficial aquifer and peat/clay unit) will be at a very slow rate due to natural attenuation mechanisms (Figure 6). Theoretically, velocities of contaminants may increase in the Quaternary alluvial aquifer and upper Providence unit.

The conditions at the NPL Site, particularly in portions of Layer 1, appear to be favorable for the natural breakdown of the organic contaminants by the action of the in situ bacterial population in the subsurface (Earth Tech, 2003). Evidence of the degradation of contaminants (natural attenuation) in both the soil and groundwater includes:

- Depressed dissolved oxygen levels,
- Elevated chloride and sulfate levels downgradient,
- Increased methane production, and

- Presence of breakdown products.

The pathways by which human and ecological populations potentially could be exposed to site-related contamination are illustrated in the CSM (Figure 5). As a result of the actions that have been completed as part of the OU1 IROD (i.e., capping of the landfill), exposure pathways for human and ecological receptors are incomplete for OU1. Human populations could be exposed to OU3 groundwater through contact with groundwater under a future residential use scenario; however, since there are no potable water wells within or downgradient of the NPL Site, there are no complete exposure pathways to human receptors under current conditions. Previous evaluation of the downgradient wetlands (Earth Tech/Rust E&I, 2000) found that human and ecological receptors were not at risk from potential discharge of contaminants inOU3 groundwater.

2.5.8 Hydrogeology

The groundwater formations underlying the NPL Site are complex. Figure 6 depicts the four aquifers beneath the NPL Site. These four aquifers consist of (from top to bottom) the surficial aquifer, the Quaternary alluvial aquifer, the Providence aquifer (divided into the upper Providence and the lower Providence units), and the Blufftown aquifer. The general groundwater flow direction within the geologic formations beneath the NPL Site is from west to east, generally towards the Ocmulgee River. The entire flood plain of the Ocmulgee River is a discharge area for groundwater. Where the Ocmulgee River has eroded part of the geologic sediments, there is a significant upward gradient from the deeper units toward the shallow Quaternary units and surface waters. Flow in the near-surface Quaternary units is generally toward the river or to smaller streams in the flood plain. The drainage ditch that forms the northern boundary of the NPL Site also acts to control local groundwater flow because shallow groundwater in the area discharges upward into the ditch from both the north and south.

Due to the complexity of the site hydrology, five “layers” that represent the aquifers or combinations of aquifers and site conditions were defined. The layers were utilized for groundwater and contaminant computer modeling purposes and to illustrate contaminant plumes. These layers are identified in Figure 6 and described below:

- Layer 1 consists of the surficial aquifer and the peat/clay unit;
- Layer 2 consists of the Quaternary alluvial aquifer and part of the Providence aquifer (upper Providence unit);

- Layer 3 consists of the Providence aquifer (upper Providence unit);
- Layer 4 consists of the Providence aquifer (lower Providence unit); and
- Layer 5 consists of the Blufftown aquifer.

2.6 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

This section describes the current and reasonably anticipated future land uses and current and potential beneficial groundwater uses at the NPL Site. Currently, land use at the NPL Site is non-residential. Future land use is to remain non-residential. For purposes of this ROD, non-residential use excludes uses typically associated with permanent, human habitation, and working environments but may include uses related to intermittent human contact that pose no threat to human health or the environment. Land use in the vicinity of the NPL Site varies from wetlands downgradient to the south and east; industrial uses upgradient to the west and north; and residential (Base housing) upgradient to the southwest. Future land use for this area of the Base is not expected to vary from the current land use. Documentation of both current and future land uses for the Base, including the NPL Site, is presented in the Base Comprehensive Plan. In addition, information regarding LUCs is also included in the Feasibility Study (Earth Tech/Rust E&I, 1999a) and the PP (Earth Tech/Rust E&I, 1999b) as a part of the Administrative Record.

Groundwater beneath the NPL Site is not currently used for drinking water or irrigation wells. However, the GA EPD considers all groundwater within the State of Georgia to be a potential source of drinking water. This policy would be equivalent to categorizing groundwater within the State of Georgia as Class I or II utilizing the Federal groundwater classification guidelines. This classification is made since the groundwater aquifers are either potential drinking water or may discharge to an ecologically important resource. It is not anticipated that groundwater will be utilized as a drinking water resource from the upper Providence unit, the Quaternary alluvial aquifer, or the surficial aquifer. The lower Providence unit, which provides non-potable water at other Base locations hydraulically removed and/or upgradient from the NPL Site, is not currently used as a drinking water resource on the Base. It is not anticipated that the future needs of the Base will require the use of this groundwater from the lower Providence unit for drinking water even though it is currently considered of quality to be used as a drinking water source.

2.7 SUMMARY OF SITE RISKS

As part of the RI process, BRAs were previously prepared for OU1 and OU3 in order to evaluate the potential risks to human health and the environment from chemicals identified during investigations at the

NPL Site. The purpose of the BRAs was to estimate baseline risk, that is, the risk the site might pose if no remedial action were taken. These assessments were used to identify the COCs and potentially complete exposure pathways, and to develop remedial goal options for COCs identified in site media. The BRAs provided the basis for determining whether or not remedial action was necessary and the justification for performing remedial action at the NPL Site. The risk assessments were presented in the RI and BRA reports (CH2M Hill, 1990; CH2M Hill, 1993; CDM, 1992; CDM, 1995; and CDM, 1996). A summary of the site-related risks identified in those earlier BRAs is provided in this section of the ROD. Chemical specific toxicological data used in the BRAs are presented in Tables 5 through 8; and the exposure assumptions used for human receptors in groundwater are presented in the footnotes of Table 9.

Based on the RI findings, contaminants from LF04 and the Sludge Lagoon historically impacted site soils and were released to the groundwater (OU3). Potential risks from site-related contaminants in these media were evaluated in the BRAs based on then current and assumed future conditions. Upon completion of the BRAs, an FS was conducted for OU1 and OU3 (Earth Tech/Rust E&I, 1999a). The following subsections provide summaries of: (1) risks from OU1, (2) risks from OU3 based on previous human health and ecological risk assessments, and (3) current risks from OU3.

2.7.1 Summary of Risk from OU1

In the 1990 BRA (CH2MHill, 1990), four human health COCs (arsenic, cadmium, chromium and chloroform) were identified in site surface soil (OU1) as posing unacceptable risks to on-site child trespassers and off-site residents under the current land use scenarios evaluated at that time. Subsequently at OU1, interim remedial actions were performed at the LF04 and the Sludge Lagoon source units. As described in Sections 1.4.1 and 2.4, interim remedial actions involving the contaminated soils and waste materials associated with LF04 and the Sludge Lagoon have included treatment, removal, and capping. The interim remedial actions that were performed at OU1 subsequent to the BRAs eliminated the previously complete exposure pathways at OU1 that were evaluated in the BRAs and through which the soil COCs potentially posed risk. The human exposure pathways associated with the downgradient wetlands were evaluated in a BRA for the OU2 wetlands (Earth Tech/Rust E&I, 2000). That BRA did not find that OU1 posed current or future risks to human receptors in the wetlands. Consequently, the wetland exposure pathways, based on stormwater runoff from OU1, were shown to be insignificant.

The BRAs for OU1 determined that there were no significant pathways for exposure of ecological receptors to contaminants in site soils under the current and future conditions evaluated. Therefore,

on-site exposure pathways associated with ecological risks were considered to be incomplete, and no ecological COCs were identified for OU1. The ecological risk assessments for OU1 were documented in Section 5.0, Environmental Risk Characterization, in Appendix M of the RI/BRA Report (CH2M Hill, 1990) and Section 6.3, Ecological Risk Assessment, in Volume I of VI in the RI/BRA Report (CH2M Hill, 1993). In addition, the ecological exposure pathways for the downgradient wetlands were evaluated in the BRA for the OU2 wetlands (Earth Tech/Rust E&I, 2000), which found that OU1 did not pose current or future risks to ecological receptors in the wetlands. Consequently, wetland exposure pathways for human receptors based on stormwater runoff from OU1 were shown to be insignificant, and no ecological COCs associated with OU1 were identified.

All potential exposure pathways previously identified for OU1 are presently considered incomplete and/or insignificant due to the completion of the Interim Actions. Exposure routes for the exposure media (i.e., air, the food chain, and surface water and sediment via stormwater runoff) have been eliminated by the capping of LF04 and the Sludge Lagoon, as well as other remedial actions. Thus, the remedial objectives for protection of human health and the environment have now been met for OU1. Accordingly, the Interim Actions conducted at OU1 are the final actions and no further remedial actions, except for LUCs, are necessary for this unit.

2.7.2 Summary of Risk from OU3

Because concentrations of some human health COCs in OU3 groundwater still exceed MCLs, additional remediation activities are required for OU3 to meet RAOs. Accordingly, this section provides a more detailed summary of the BRAs that provided the basis of the ongoing remedial actions for OU3. The following subsections provide summaries of the previous human health risk assessments for OU3, the previous ecological risk assessments for OU3, and current risks from OU3.

2.7.2.1 Summary of Previous Human Health Risk Assessments for OU3

The methods and results of the BRAs previously performed to evaluate risk from OU3 are described below based on four main components of a BRA:

2.7.2.1.1 Identification of Chemicals of Concern

- The ultimate result of the exposure assessment, effects assessment, and risk characterization described below was the identification of COCs in OU3 groundwater based on cancer risk and/or

noncancer hazard. The human health COCs identified in the previous BRAs for OU3 indicated the need for remedial action regarding OU3. These COCs, which were identified in groundwater based on potential exposures of hypothetical future on-site residents, are listed in Table 4 and are summarized below by aquifer:

- Quaternary alluvial aquifer: thirteen volatile organic compounds (VOCs), ten metals, three polynuclear aromatic hydrocarbons (PAHs), and dieldrin;
- Upper Providence unit: nine VOCs, five metals (arsenic, beryllium, cadmium, vanadium, and zinc), 2,4-dinitrophenol, and dieldrin;
- Lower Providence unit: three VOCs (bromomethane, trans-1,3-dichloropropene, and TCE), four metals (arsenic, beryllium, cadmium, and zinc), 2,4-dinitrophenol, and dieldrin;
- Blufftown and Cusseta aquifer: four metals (arsenic, beryllium, cadmium, and zinc).

In BRAs, the exposure point concentration (EPC) for a chemical typically is based on the 95 percent upper confidence limit of the arithmetic mean concentration (US EPA, 2000a). However, for sites with limited amounts of data or extreme variability in the data, the maximum detected concentration is commonly used as a default EPC. For each COC in groundwater (OU3), the EPC and the basis for deriving this value are also presented in Table 4. As indicated on the table, the maximum detected concentration was conservatively used as the "upper bound" EPC in the risk assessments for the site (i.e., the concentration that was used to estimate the highest exposure and associated risk from each COC). It should also be noted that the BRAs also calculated exposures based on mean concentrations in order to provide a plausible range of risks in support of risk management decisions for the NPL Site.

2.7.2.1.2 Exposure Assessment

The exposure assessment components of the BRAs for OU3 were documented in Section 4.2, Exposure Pathway Assessment, in Appendix M of the RI/BRA Report (CH2M Hill, 1990) and Section 6.2.3, Exposure Assessment, in Volume 1 of 6 in the RI/BRA Report (CH2M Hill, 1993). In the BRAs, potential human exposure pathways were identified based on consideration of current and potential future land uses of the site and surrounding areas. A complete pathway includes a chemical source and release mechanism, a transport or retention medium, an exposure point where human contact with the contaminated medium occurs, and a route of intake for the contaminant into the body at the exposure point. If any one of these elements is missing, the pathway is incomplete and is not considered further in the risk assessments.

As presented in the site-specific CSM diagram (Figure 5), potentially complete exposure pathways were evaluated in the BRAs based on current land use scenarios at the time the BRAs were performed. When the BRAs were performed there were no on-site water supply wells, which continues to be in agreement with the current conditions; consequently, potential human exposure pathways to groundwater were considered to be incomplete. Hypothetical future land use scenarios were evaluated based on the assumption of potential future use of on-site groundwater as a potable water supply for on-site residents, in accordance with US EPA Region IV guidance (US EPA, 1989a). Future residents were assumed to be exposed to COCs in groundwater via ingestion of tap water and inhalation of water vapors. Groundwater exposures were conservatively evaluated, given that there are presently no potable groundwater wells at the site, and on-site groundwater is not likely to be used as a water supply source in the future.

Receptors and pathways evaluated in the BRAs also included off-site child trespassers/recreators exposed to surface water, sediment, and fish from the downgradient wetlands. However, the US EPA, the GA EPD, and Robins AFB agreed in 2003 that the contamination found in the adjacent wetlands did not originate from OU1 (US EPA, 2003b). Accordingly, these surface water, sediment, and fish pathways are not included herein.

Chemical-specific intakes (estimated doses) were calculated for the potential receptors and their exposure pathways as part of the quantitative evaluation in the BRAs. These estimates were based on the chemical- and medium-specific EPCs for the COCs and default and/or site-specific exposure assumptions. These exposure assumptions were developed using US EPA risk assessment guidance such as the *Risk Assessment Guidance for Superfund* (US EPA, 1989a) and the *Exposure Factors Handbook* (US EPA, 1989b and 1990a). The exposure factors used to estimate intake and dose (including exposure frequency, exposure duration, exposure time, body weight, and intake rates) for the future residential scenarios in the BRAs are presented within the footnotes of the risk calculation summary table (Table 9).

2.7.2.1.3 Toxicity Assessment

The toxicity assessment components of the BRAs for OU3 were documented in Section 3.0, Toxicity Assessment, in Appendix M of the RI/BRA Report (CH2M Hill, 1990) and Section 6.2.2, Toxicity Assessment, in Volume 1 of the RI/BRA Report (CH2M Hill, 1993). The toxicity assessments used data available at the time the BRAs were performed regarding the potential of each COC to cause adverse health effects in exposed individuals. Two categories of toxicity were evaluated: cancer risk from carcinogens and noncancer hazard from noncarcinogens. The chemical-specific toxicological data used

in the BRAs are presented in Tables 5 through 8. The cancer toxicity data available for the COCs is presented in Table 5 (for oral/dermal exposures) and Tables 6a and 6b (for inhalation exposures). The noncancer toxicity data available for the COCs is presented in Tables 7a and 7b (for oral/dermal exposures) and Table 8 (for inhalation exposures).

In evaluating carcinogenic effects, the slope factor (SF) was used in the BRAs to estimate an upper-bound lifetime probability of an individual developing cancer as a result of exposure to a particular level of a potential carcinogen. The chemical-specific SFs used for carcinogenic COCs in the BRAs, and their weight-of-evidence classification based on the strength of the evidence that the chemical is a human carcinogen, are presented in Tables 5, 6a, and 6b based on the oral, dermal, and inhalation routes of exposure, respectively**.** It should be noted that inhalation SFs for the eight volatile COCs were not documented in the 1993 BRA, as shown in Table 6a. However, in order to provide thorough documentation of currently available toxicological information for the COCs, supplemental inhalation SFs have been provided in this ROD for those COCs that lacked such data in the 1993 BRA (Table 6b).

Evaluation of noncarcinogenic effects in the BRAs was based on the reference dose (RfD), defined as an estimate of a daily exposure level to a specific chemical that is not expected to cause any deleterious noncancer effect. The chemical-specific RfDs based on the oral and dermal routes of exposure are presented in Tables 7a and 7b. Dermal RfDs are not presented since there were no noncarcinogenic COCs identified for the dermal exposure pathway. Information regarding the type of effect (e.g. chronic or subchronic), target organ, and factors used in deriving the oral RfDs were not presented in the BRAs, and inhalation RfDs were not presented in the 1993 BRA. However, in order to provide thorough documentation of currently available toxicological information for the COCs, available noncancer toxicity data were added as supplemental information in this ROD in Tables 7b and 8.

The sources of toxicity data in the previous BRAs are shown in Tables 5, 6a, 7a, and 8. For the COCs in soil (CH2M Hill, 1990), the toxicity values used were primarily obtained from the US EPA Integrated Risk Information System (IRIS) (US EPA, 1988). If values were not available from IRIS, the Health Effects Assessment Summary Tables (HEAST) (US EPA, 1989c) or the Superfund Public Health Evaluation Manual (SPHEM) (US EPA, 1986) were consulted in this assessment. For the COCs in groundwater identified in the BRA (CH2M Hill, 1993), the toxicity values used in the assessment were also primarily obtained from IRIS (US EPA, 1992a). If values were not available from IRIS, HEAST

(US EPA, 1992b) or the Environmental Criteria and Assessment Office (no reference provided in report) were consulted.

In the supplemental tables of toxicity values provided in this ROD (Tables 6b, 7b, and 8), values were also obtained primarily from IRIS. If toxicity values were not available from IRIS, HEAST, or the Superfund Health Risk Technical Support Center–National Center for Environmental Assessment (SHRTSC-NCEA) of the US EPA were consulted. IRIS and HEAST toxicity values were obtained from the Electronic Handbook of Risk Assessment Values (EHRAV, 2000). The SHRTSC-NCEA values were obtained from the US EPA Risk-Based Concentration Table (US EPA, 2000b).

2.7.2.1.4 Risk Characterization

The risk characterization components of the BRAs for OU3 were documented in Section 4.3, Public Health Risk Characterization, in Appendix M of the RI/BRA Report (CH2M Hill, 1990), and Section 6.2.4, Risk Characterization, in Volume 1 of 6 in the RI/BRA Report (CH2M Hill, 1993). This section summarizes the BRA results, uncertainties and assumptions associated with the BRAs, and conclusions of the BRAs with regard to OU3.

Summary of BRA Results

For carcinogens, risks are expressed as the incremental probability of an individual developing cancer over a lifetime (e.g. 70 years) as a result of exposure to the carcinogen. The cancer risk estimate (expressed as a unitless probability) is the lifetime average daily dose [chronic daily intake (CDI)] multiplied by the SF. Risks are standardly expressed in scientific notation (e.g., 1E-06 or 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as "an excess lifetime cancer risk" for the individual because this risk would be in addition to the cancer risks that may result from other causes that are not site-related. US EPA's generally acceptable cancer risk range for site-related exposures is 10^{-4} to 10^{-6}. Risks greater than one excess cancer in one million people (10^{-6}) are considered potentially significant by the GA EPD. The GA EPD benchmark was used for determining COCs. Therefore, those chemicals identified during the risk characterization as contributing significantly (chemical-specific risk that equals or exceeds 1E-06) to a medium with a total cancer risk of 1E-06 or greater were classified as human health COCs.

For noncarcinogens, effects were evaluated by dividing an estimated exposure level (CDI or dose) by the RfD to calculate a hazard quotient (HQ) for the chemical in that medium. The CDI and the RfD are expressed in the same units and represent the same exposure period (i.e., chronic, sub-chronic, or short-term). An HQ less than 1.0 generally indicates that toxic noncarcinogenic effects from that chemical are unlikely because the receptor's dose of the chemical is less than the RfD. A hazard indices (HI) is calculated by adding the individual HQs for all chemicals that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may be reasonably exposed. An HI greater than 1.0 indicates that site-related exposures to contaminants may present a hazard to human health [i.e., a chemical may be identified as a COC if it contributes significantly (HQ of 0.1 or greater) to a critical effect HI of 1.0 or greater for a particular pathway].

Risks from carcinogenic COCs and hazards from noncarcinogenic COCs from potential exposures of future on-site residents to groundwater are presented in Table 9. The risk and hazard estimates presented in these tables are consistent with the information presented in the BRAs. As documented in the 1993 BRA, specific risk and hazard estimates are presented for each groundwater monitoring well within each aquifer under the future residential scenario and include total risks and hazards associated with each well based on all chemicals of potential concern (i.e., not limited to COCs only). Cumulative total risks and hazards for all wells are not presented in these tables, as this information was not documented in the BRA (only well-specific risks were presented in the BRA to provide a spatial representation of area risks). It should also be noted that since the primary target organs for associated noncarcinogenic COCs were not presented in the BRAs, such information is not included in the hazard calculations in Table 9. (However, as previously discussed, target organs for the COCs are presented on Tables 7b and 8.)

For carcinogens, as noted above, total cumulative risks were not calculated for groundwater exposures. For the future residential scenario, the maximum total cancer risks from on-site wells from each aquifer were calculated in the 1993 BRA to be 3.0E-01 (at LF4-4) in the Quaternary alluvial aquifer, 5.0E-05 (at LF4-38) in the upper Providence unit, 4.0E-05 (at LF4-43) in the lower Providence unit, and 3.0E-04 (at LF4-BL1) in the Blufftown and Cusseta aquifer (Table 9). With the exception of groundwater from the Quaternary alluvial aquifer and Blufftown and Cusseta aquifer, all of these total cancer risks exceeded the GA EPD benchmark of 1E-06 but were within the US EPA target risk range of 1E-06 to 1E-04. Total cancer risks from groundwater in the Quaternary alluvial aquifer and the Blufftown and Cusseta aquifer exceeded the US EPA target risk range as well as the GA EPD benchmark.

For noncarcinogens, as noted above, total cumulative HIs were not calculated for groundwater exposures. For the future residential scenario, the maximum HIs from on-site wells from each aquifer were 429.3 (at LF4-6) in the Quaternary alluvial aquifer, 1.4 (at LF4-42) in the upper Providence unit, 2.5 (at LF4-PR1) in the lower Providence unit, and 11.8 (at LF4-BL3) in the Blufftown and Cusseta aquifer (Table 9). All of these HIs exceed the US EPA and the GA EPD benchmark of 1.0, with the majority of these exceedances based on COCs in groundwater from the Quaternary alluvial aquifer and the Blufftown and Cusseta aquifer.

Overall, the results of the quantitative risk characterization in the BRAs indicated that there were unacceptable cancer risks and noncancer hazards to potential human receptors associated with site-related COCs (i.e., VOCs and metals) in OU3 groundwater under a hypothetical future residential land use scenario. A total of 28 human health COCs (including 13 volatile organic compounds (VOCs), three PAHs, 11 metals, and dieldrin) were identified by the BRAs in groundwater from the Quaternary alluvial aquifer, the upper and lower Providence units, and the Blufftown and Cusseta aquifer.

All total cancer risks, except for groundwater from the Quaternary alluvial aquifer, exceeded the GA EPD benchmark but were within the US EPA acceptable risk range. Total cancer risks also significantly exceeded the US EPA target risk range for COCs in groundwater from the Quaternary alluvial aquifer. Total noncarcinogenic hazard assessed using HIs exceeded the US EPA and the GA EPD benchmark of 1.0, with significant contributions from COCs in both the Quaternary alluvial aquifer and Blufftown and Cusseta aquifer. Consequently, based upon these BRA findings, remedial actions were recommended for OU3 to address potential human health risks from the groundwater COCs.

BRA Uncertainties and Assumptions

Uncertainties and assumptions are inherent in the process of risk assessment. This section provides a discussion of the uncertainties associated with key site-related variables and major assumptions used in the BRAs in order to address their potential effect on the risk and hazard estimates.

Sampling and Analysis: The RI sampling data collected at any on-site location were inevitably a limited subset of the nearly unlimited quantity of data that potentially could have been collected, and as such, may not have been completely representative of site contaminant levels. Overall, the quality assurance/quality control program implemented in the RI served to reduce sources of variability, although

some degree of variability or standard error in the analyses, representativeness of samples, sampling variability, and heterogeneity of the sample matrix was inevitable.

Environmental Fate and Transport: The quantitative assessment in the BRAs assumed that no contaminant loss or transformation of site contaminants had occurred. Concentrations of COCs used in the BRAs were based on chemical concentrations from the RI sampling that were not reduced to account for degradation, dilution, or dispersion. This assumption was very conservative and likely resulted in overestimation of risks and hazards associated with the site, especially for VOCs.

Exposure Estimation: The evaluations of potential exposure pathways and receptors were based on potential current and hypothetical future land uses identified at the time the BRAs were performed. Site-specific receptors were identified to the extent possible and exposure parameters were tailored to these receptors to minimize uncertainty in the postulated exposure scenarios and the exposure assessment. Although an unlikely scenario, given that the reasonably anticipated future land use at the units will remain industrial, the hypothetical future residential scenario was evaluated in the BRAs in accordance with US EPA Region IV guidance (US EPA, 1989a). Potential use of on-site groundwater from each of the four aquifers was also quantitatively assessed in the BRAs, although there are no existing on-site water supply wells and site groundwater is not expected to be used as a potable water supply source under future conditions.

Values assumed for exposure parameters (e.g., exposure frequency, exposure duration, exposure time, body weight, and intake rates) used in calculations of receptor intakes were based primarily on recommended default values from US EPA risk assessment guidance. These assumptions may have resulted in either the underestimation or overestimation of intakes, depending on the accuracy of the assumptions relative to actual site conditions and land uses. Dermal exposures were not quantified, which may have contributed to uncertainty regarding total risk estimates. Maximum detected concentrations of chemicals were used to represent highest potential exposures (e.g., upper bound), which is likely to have overestimated risks and hazards.

Toxicological Data: Uncertainties associated with toxicological data included extrapolation from high to low doses and from animals to humans; species differences in uptake, metabolism, and organ distribution; species differences in target site susceptibility; and human population variability with respect to diet, environment, activity patterns, and cultural factors. The assumption that all of the chemical effects were

additive may have resulted in either the underestimation or overestimation of risks because concurrent exposure to several contaminants may either have synergistic or antagonistic effects. In the BRAs, the absence of toxicity values for some of the COCs may have contributed to the underestimation of risks and hazards.

BRA Conclusions for OU3

In the 1993 BRA, human health COCs identified in OU3 groundwater included several VOCs, PAHs, metals, and dieldrin in the Quaternary alluvial aquifer and the upper Providence and lower Providence units and metals in the Blufftown and Cusseta aquifer under a future residential land use scenario (i.e., assuming potential future use of on-site groundwater as a potable water supply). The GA EPD requires all groundwater to be considered a potential drinking water source regardless of the reasonably anticipated future land use. Accordingly, it was concluded based on the BRA results, that the OU3 groundwater required remediation to protect public health or welfare or the environment from actual or threatened releases of hazardous substances from this site. Interim remedial actions were subsequently performed to address the risks and COCs identified in the BRA based on future use of groundwater. Under current land use scenarios, there were no potentially complete pathways to site groundwater.

2.7.2.2 Summary of Previous Ecological Risk Assessments for OU3

In the BRAs for OU3, it was determined that there is no exposure of ecological receptors to site groundwater under current and reasonably anticipated future conditions. Therefore, on-site exposure pathways associated with ecological risks were considered to be incomplete and no ecological COCs were identified. The ecological risk assessments for OU3 were documented in Section 5.0, Environmental Risk Characterization, in Appendix M of the RI/BRA Report (CH2M Hill, 1990) and Section 6.3, Ecological Risk Assessment, in Volume 1 of 6 in the RI/BRA Report (CH2M Hill, 1993). As discussed above for OU1, the ecological exposure pathways based on groundwater discharge to the downgradient wetlands were evaluated in the OU2 Wetlands BRA (Earth Tech/Rust E&I, 2000), which found that OU3 did not pose current or future risks to ecological receptors in the wetlands. Consequently, wetland exposure pathways for ecological receptors based on discharge of OU3 groundwater were shown to be insignificant, and no ecological COCs were identified for OU3. Overall, based on the findings of the BRAs, no ecological COCs were identified for OU3 (groundwater) under either the then current or potential future ecological exposure scenarios.

2.7.2.3 Summary of Current Risk from OU3

Interim remedial activities were conducted at the NPL Site following the completion of the 1993 BRA and prior to the development of the FS for OU3 and OU1 (Earth Tech/Rust E&I, 1999a). In order to consider the effects of these interim actions, additional groundwater screening was performed during the FS to identify the final COCs in groundwater that needed to be addressed under the remedial action for OU3. The FS also developed remedial goals to address the potential risks associated with the COCs in OU3 groundwater.

The final COCs identified by the FS were those constituents with maximum detected concentrations in OU3 groundwater that exceeded their respective MCLs. The concentrations used in the screening were based on laboratory analytical data from the Spring 1998 basewide groundwater sampling event, which were the most recent analytical data available for use in the reevaluation of COCs in the 1999 FS (Rust E&I, 1998a). The MCLs used in the evaluation were risk-based values protective of human health and the environment, as defined in the Federal Drinking Water Regulations and Health Advisories (US EPA, 1996). Chemicals with maximum detected concentrations in groundwater that were less than their respective MCLs were not identified as final COCs in groundwater and were eliminated from further evaluation in the FS. Each chemical that exceeded its respective MCL was further evaluated in the FS based on additional considerations, including its frequency of detection, detected concentration relative to its MCL (i.e., statistical difference), and frequency of detection above its MCL. Based on this evaluation, the constituents identified as COCs in groundwater included several VOCs and metals in the surficial and Quaternary alluvial aquifers and the upper Providence unit (Table 2).

A more recent analysis of data collected by the annual basewide groundwater sampling program during the period 1999 through 2003 indicated that two of the inorganics previously identified as COCs (nickel in the surficial aquifer and chromium in the Quaternary alluvial aquifer) should no longer be considered COCs (Appendix A). Therefore, the "final" COCs identified for the OU3 groundwater were those shown in Table 10, which provides detected concentrations (e.g., minimum, maximum, and mean), frequencies of detection, and exposure point concentrations for the COCs from the Spring 1998 basewide sampling.

Based on the 1993 BRA and the results of the final COC identification in the FS, it was concluded that the lower Providence unit and Blufftown aquifer either did not contain site-related constituents or the constituents present were eliminated as a concern based on other lines of evidence. As discussed in the FS, chemicals detected in these groundwater layers included bis(2-ethylhexyl)phthalate (BEHP) in

groundwater from the lower Providence unit and Blufftown aquifer, and nickel and chromium in groundwater from the lower Providence unit. The estimated detected concentrations of BEHP in groundwater samples were concluded to be laboratory artifacts (i.e., the blank was contaminated); therefore, BEHP was not considered to be site-related. Detected concentrations of chromium and nickel (as well as BEHP in groundwater from the upper Providence unit) only exceeded their respective MCLs in one sample and were eliminated based on the infrequency of their MCL exceedances. As a result, no final COCs were identified in the lower Providence unit or Blufftown aquifer.

More recent data for the OU3 groundwater COCs are shown in Table 3. This table provides the maximum detected concentration of each COC in each aquifer/unit, the well at which that concentration was detected, and the current MCL for each COC (US EPA, 2003a). It also shows for comparison the maximum detected concentrations from the Spring 1998 basewide sampling data that were previously evaluated in the FS. Comparison of the 2003 data to the 1998 data indicates that the maximum detected concentrations of many COCs have decreased, particularly in the surficial aquifer.

2.8 REMEDIAL ACTION OBJECTIVES

The RAOs address unit-specific contaminants (e.g. final COCs), media of concern, potential exposure pathways, and remediation goals. The RAOs are based on the nature and extent of contamination, threatened resources, and the potential for human and environmental exposure. Initially, preliminary remediation goals are developed based upon ARARs or other information from the RIs and BRAs. The RAOs for OU1 (containment) will be met through the implementation of the Interim Action remedies and institutional controls/LUCs. All potential exposure pathways for OU1 are presently considered incomplete and/or insignificant due to the completion of the Interim Actions.

The RAOs will be met for OU3 by implementing the remedy described in this ROD. Based on the evaluation of the BRA, chemical-specific ARARs (i.e., MCLs), and the potential exposure route and receptors, the RAOs for OU3 groundwater in the surficial aquifer, the Quaternary alluvial aquifer, and the upper Providence unit are to:

- Prevent the use of groundwater having potential carcinogens and noncarcinogens in excess of established Federal and State ARARs (MCLs) through containment and institutional controls/LUCs,

- Restore the surficial aquifer, Quaternary alluvial aquifer, and the upper Providence unit to established MCLs (Table 2), if technically feasible, and
- Prevent potential impact to the neighboring wetlands.

The risks associated with containment for OU1 are greater than those associated with complete removal actions; therefore, institutional controls/LUCs are necessary for protection of human and ecological receptors. Containment for OU1 and OU3 includes institutional controls/LUCs as outlined under Section 2.12 (*Selected Remedy)* of this ROD. Because the anticipated future land use for this site is non-residential, containment for both OU1 and OU3 was selected as a RAO. Because all groundwater is classified as potential drinking water, RAOs for OU3 include treatment of groundwater to drinking water standards.

2.9 DESCRIPTION OF ALTERNATIVES

As part of the investigation/assessment process for the NPL Site, OUs 1 and 3, a FS was performed using groundwater data from the 1998 basewide sampling event (Rust E&I, 1998a). Detailed information regarding the development and evaluation of remedial alternatives can be found in the FS report (Earth Tech/Rust E&I, 1999a). Through issuance and acceptance of the ISA, the remedy for OU1 (containment through capping in place) and institutional controls/LUCs has already been chosen as the final remedy; therefore, no alternatives for OU1 are presented.

The NCP directs that a range of alternatives, including treatment and containment combinations, be evaluated. Consideration of a "no action" alternative is required by the NCP. However, it should be noted that in the FS and per the agency-approved ISA (Robins AFB, 1998), the "no action" alternative included certain aspects of the Interim Action presently being conducted at OU3. In order to provide alternatives that provide no engineered remedies, a "baseline conditions" alternative and a MNA remedy were developed.

Remedial alternatives were derived from technologies retained following a screening evaluation presented in the FS report (Earth Tech/Rust E&I, 1999a). Based on computer modeling presented in the FS, the estimated time to reach remediation goals for all alternatives was greater than 30 years. For preparing cost estimates for each alternative, the NCP limits the time period to 30 years. Therefore, each of the cost estimates presented in the FS were compiled for a time period also equal to 30 years. However, it should

be noted that based on data from 1999 to present (2003), remediation time is likely to be much shorter than 30 years, as indicated in Figures 8, 11, 12, 14, 15, 17, 19, and 22.

Remediation goals are based on ARARs. ARARs are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal, State, or local environmental law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. For OU3 (groundwater), only MCLs have been identified as chemical-specific ARARs. Although the groundwater is not a current source of drinking water, all groundwater in Georgia is classified as a potential source of drinking water. As such, MCLs are the current RAOs for groundwater contaminants. The chemical-specific MCLs for the final COCs (Table 10) in groundwater are presented in Table 2.

2.9.1 Description of Remedy Components

For OU3 (groundwater), eight alternatives were evaluated as part of the FS performed in 1998 and 1999. Consideration of a "no action" alternative is required by the National Oil and Hazardous Substances Contingency Plan. However, in the Feasibility Study (Earth Tech/Rust E&I, 1999a), the PP (Earth Tech/Rust E&I, 1999b), and per the US EPA approved ISA (Robins AFB, 1998), the "no action" alternative included certain aspects of the Interim Action previously conducted for OU3. In order to provide an alternative that provides no engineered remedies, a "Baseline Conditions Alternative" (Alternative 1) was developed as the scenario where "no action" is taken. A summary of the following alternatives can be found in Table 11. The major components of each alternative are presented below:

Alternative 1: Baseline Conditions Alternative

- Institutional controls/LUCs would no longer be maintained.
- The OU3 Interim Action groundwater extraction system would be shut down.

Alternative 2: Monitored Natural Attenuation

- Institutional controls/LUCs would be maintained to control exposure.
- The OU3 Interim Action groundwater extraction system would be shut down.
- Natural attenuation mechanisms would reduce COC concentrations to below MCLs.
- Natural attenuation parameters and chemical contaminants would be routinely monitored to determine if natural attenuation was effective.

Alternative 3a: No Action – Continued Operation of the Existing OU3 Interim Action

- The OU3 Interim Action groundwater extraction system and treatment system would continue to operate under current operating conditions.
- Groundwater would be periodically monitored to ensure contaminant reductions.
- Robins AFB would maintain institutional controls/LUCs to control incidental exposure.

Alternative 3b: Optimized Operation of the Existing OU3 Interim Action

- The OU3 Interim Action groundwater extraction system would be optimized by evaluating the efficiency and effectiveness of the system. When the evaluation of the data for two groundwater sampling events indicate that the continued operation of the system is less efficient and effective than MNA, documentation will be provided by the Air Force to the US EPA and GA EPD to justify the technical decision for turning off the groundwater extraction system and transitioning to MNA. The supporting data may include the analytical results, isoconcentration maps, contaminant trend analyses, groundwater extraction rate data, contaminant mass removal data, system operating costs, and revised groundwater and transport modeling, as applicable. The supporting data will sufficiently document the groundwater treatment system's efficiency and effectiveness. This evaluation, subject to the US EPA and GA EPD review and approval, will allow for deactivating the OU3 groundwater extraction system and transitioning to MNA when it is determined that MNA is the most appropriate remedial strategy.
- Residual contaminants not captured by the system would be reduced by natural attenuation mechanisms.
- Groundwater would be periodically monitored to ensure contaminant reductions.
- Robins AFB would maintain institutional controls/LUCs to control incidental exposure.

Alternative 4: Hot Spot Remediation with Monitored Natural Attenuation

- The OU3 Interim Action groundwater extraction system would be shut down.
- Air sparging wells would be installed in the surficial aquifer and Quaternary alluvial aquifer where elevated concentrations of organics exist (hot spots).
- Air sparging system would volatilize the elevated concentrations of organics.
- Volatilized organics would migrate with air within the LF04 waste debris/soils and be captured at soil vapor extraction (SVE) well points.
- If necessary, volatile organics would be treated in the air stream via thermal oxidation or other appropriate means.

- In addition to the air sparging system, extraction wells would be installed within the surficial aquifer and Quaternary alluvial aquifer where elevated levels of metals exist.
- Extracted groundwater would be treated by an ex-situ, presumed remedy for metals, if necessary.
- Residual contaminants in the groundwater not captured by the system would be reduced by natural attenuation.
- Groundwater would be periodically monitored to ensure contaminant reductions.
- Robins AFB would maintain institutional controls/LUCs to control incidental exposure.

Alternative 5a: Hot Spot Remediation With Continued Operation Of The Existing OU3 Interim Action

- Same as Alternative 4 with the exception of continuing to operate the OU3 Interim Action groundwater extraction system.
- The OU3 Interim Action groundwater extraction system would remain active and operate as described in the IROD.
- All other aspects of hot spot remediation discussed under Alternative 4 would be the same for Alternative 5a.
- Groundwater would be periodically monitored to ensure contaminant reductions.
- Robins AFB would maintain institutional controls/LUCs to control incidental exposure.

Alternative 5b: Hot Spot Remediation with Operation of an Optimized OU3 Interim Action System

- Hot spot removal as indicated in Alternative 4 except that the OU3 Interim Action groundwater extraction system would be optimized to maximize the removal of contaminants.
- All other aspects of hot spot remediation discussed under Alternative 4 would be the same for Alternative 5b.
- Groundwater would be periodically monitored to ensure contaminant reductions.
- Robins AFB would maintain institutional controls/LUCs to control incidental exposure.
- The number of extraction wells would be operated to capture elevated levels of contaminants while allowing residual contaminants not captured by the system to be reduced by natural attenuation.

Alternative 6: Extraction of Impacted Groundwater

- Alternative 6 would be an attempt to restore aquifers to natural conditions utilizing a completely engineered extraction system.

- Installation of the metals hot spot extraction wells discussed under Alternative 4 would be included.
- Installation of seven new extraction wells near the perimeter of LF04 would be included.
- The OU3 treatment system discussed in Alternative 3 would be utilized for the treatment of extracted groundwater under Alternative 6.
- Alternative 6 includes a continued monitoring program to verify the reduction in contaminant concentrations, monitor migration pathways, and evaluate the effectiveness of the extraction system.

2.9.2 Common Elements and Distinguishing Features of Each Alternative

Common elements distinguishing each alternative are listed below. The evaluation of these elements is crucial in verifying that the chosen remedy is the best suited for the NPL Site.

Key ARARs

For all alternatives evaluated, the chemical- and location-specific ARARs are the same. The chemical-specific ARAR is remediation of groundwater to drinking water standards (MCLs). The location-specific ARAR is meeting Georgia water quality standards (WQS) for the natural discharge of OU3 groundwater to the wetlands surface water. An additional location-specific ARAR is the protection of floodplains and the protection of threatened and/or endangered species. Action-specific ARARs, which differ for each alternative, are listed below:

- Alternative 1: (Baseline Conditions): None
- Alternative 2: (Monitored Natural Attenuation): None
- Alternative 3a: (No Action – Continued Operation of the Existing OU3 Interim Action Groundwater Extraction System and Treatment System): None -- The action-specific ARARs associated with Alternative 3a were managed as part of the OU3 Interim Action.
- Alternative 3b: (Optimized Operation of the Existing OU3 Interim Action Groundwater Extraction System): Same as alternative 3a.
- Alternative 4: (Hot Spot Remediation with Monitored Natural Attenuation): The action-specific ARARs associated with this alternative include control of air emissions from groundwater treatment units.

- Alternative 5a: (Hot Spot Remediation with Continued Operation of the Existing OU3 Interim Action Groundwater Extraction System): Same as alternative 4.
- Alternative 5b: (Hot Spot Remediation with Operation of an Optimized OU3 Interim Action Groundwater Extraction System): Same as alternative 4.
- Alternative 6: (Extraction of Impacted Groundwater): Same as alternative 4.

Long-Term Reliability

The alternatives were also evaluated on long-term reliability or the potential for remedy failure/replacement costs. If a remediation system is installed, it is expected that it will perform as it has historically for other sites. Some of the alternatives evaluated included a remediation system (air sparging) that had a high level for failure based on previous attempts to use this technology at the NPL Site. Reliability of the alternatives are provided below:

- Alternative 1: No Reliability
- Alternative 2: Very Low Reliability (MNA only not likely to achieve RAOs)
- Alternative 3a: High Reliability (system and performance already proven)
- Alternative 3b: High Reliability (system and performance already proven)
- Alternative 4: Very Low Reliability (air sparging/SVE previously tried unsuccessfully)
- Alternative 5a: Very Low Reliability (air sparging/SVE previously tried unsuccessfully)
- Alternative 5b: High Reliability (scaled-up version of proven technology)
- Alternative 6: High Reliability

Quantity of Untreated Waste/Degree of Hazards Remaining Due to Containment

The hazards (concentrations) remaining due to containment of OU3 (groundwater) is dependent upon the length of time for cleanup to occur. It should be noted that groundwater modeling performed in the 1999 FS shows that a portion of the metals in the surficial aquifer are not remediated through extraction with any scenario nor do they migrate off-site since they are bound to the soils in the waste mass through natural attenuation mechanisms. The longer the estimated cleanup, the higher the concentrations remaining in the groundwater (OU3) and the greater the risks. The relative risks associated with contaminants left in OU3 are shown below:

- Alternative 1: High Risk
- Alternative 2: High Risk
- Alternative 3a: Medium Risk
- Alternative 3b: Medium Risk
- Alternative 4: Medium Risk
- Alternative 5a: Medium Risk
- Alternative 5b: Medium Risk
- Alternative 6: Low to Medium Risk

Estimated Time For Design and Construction

- Alternative 1: Immediate implementation
- Alternative 2: Immediate implementation
- Alternative 3a: Immediate implementation
- Alternative 3b: Immediate implementation
- Alternative 4: 18 Months
- Alternative 5a: 18 Months
- Alternative 5b: 18 Months
- Alternative 6: 30 Months

Estimated Time To Reach Remediation Goals

Based on modeling performed during the 1999 FS, variations in estimated timeframes to achieve remediation goals were determined. These comparative timeframes are indicated below:

- Alternative 1: Greater than 70 years
- Alternative 2: Greater than 50 years
- Alternative 3a: Less than 30 years
- Alternative 3b: Less than 30 years
- Alternative 4: Greater than 40 years
- Alternative 5a: Less than 30 years
- Alternative 5b: Less than 30 years
- Alternative 6: Less than 30 years

Estimated Capital, Annual O&M, and Present Worth Costs

- Alternative 1: Capital: $0
  Annual O&M: $0
  Present Worth Cost: $76,000
- Alternative 2: Capital: $0
  Annual O&M: $65,000
  Present Worth Cost: $882,000
- Alternative 3a: Capital: $1,000,000
  Annual O&M: $1,000,000
  Present Worth Cost: $11,587,000
- Alternative 3b: Capital: $500,000
  Annual O&M: $932,000
  Present Worth Cost: $7,042,000 (10 year scenario)
  Present Worth Cost: $12,059,000 (30 year scenario)
- Alternative 4: Capital: $1,800,000
  Annual O&M: $124,000
  Present Worth Cost: $3,562,000
- Alternative 5a: Capital: $2,800,000
  Annual O&M: $1,200,000
  Present Worth Cost: $17,914,000
- Alternative 5b: Capital: $2,800,000
  Annual O&M: $1,200,000
  Present Worth Cost: $17,914,000
- Alternative 6: Capital: $10,000,000
  Annual O&M: $3,000,000
  Present Worth Cost: $47,450,000

Use of Presumptive Remedies and/or Innovative Technologies

A presumptive remedy was used for OU1 (LF04 and Sludge Lagoon cap). There were no innovative technologies (as defined by the US EPA) included in any of the alternatives considered for OU3 (groundwater).

Expected Outcomes Of Each Alternative

Due to the institutional controls/LUCs that will be in place at the NPL Site, it is anticipated that upon cleanup, the land will continue to be used for non-residential purposes. For purposes of this ROD, non-residential use excludes uses typically associated with permanent, human habitation, and working environments but may include uses related to intermittent human contact that pose no threat to human health or the environment. Because containment with institutional controls/LUCs is the chosen remedy for OU1, none of the OU3 alternatives would remediate the NPL Site to warrant residential land use. A comparison of the alternatives with respect to groundwater use is shown below:

- Alternative 1: Cleanup goals are not likely to be achieved and therefore groundwater would not be available for future use.
- Alternative 2: Cleanup goals are not likely to be achieved and therefore groundwater would not be available for future use.
- Alternative 3a: Cleanup goals are estimated to be achieved in less than 30 years.
- Alternative 3b: Cleanup goals are estimated to be achieved in less than 30 years.
- Alternative 4: Cleanup of groundwater is not likely due to high risk of failure of remedial method.
- Alternative 5a: Cleanup goals are estimated to be achieved in less than 30 years.
- Alternative 5b: Cleanup goals are estimated to be achieved in less than 30 years.
- Alternative 6: Cleanup goals are estimated to be achieved in less than 30 years.

2.10 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Each of the remedial alternatives was evaluated using the nine criteria established by the NCP. The criteria were derived from the statutory requirements of CERCLA Section 121. The NCP [40 CFR § 300.430 (e) (9)] sets forth nine evaluation criteria that provide the basis for evaluating alternatives and selecting a remedy.

Table 11 presents a comparative analysis of alternatives. In selecting the preferred alternative, the criteria referenced in Table 11 were used to evaluate all of the alternatives developed in the FS report (Earth Tech/Rust E&I, 1999a). Seven of the criteria are used to evaluate all the alternatives based on human health and environmental protection, cost, and feasibility issues. The alternatives are further evaluated based on the final two criteria: State acceptance and community acceptance.

2.11 PRINCIPAL THREAT WASTES

The NCP establishes an expectation that treatment will be used to address the principal threats posed by a site whenever practicable (NCP § 300.430(a)(1)(iii)(A)). Identifying principal threat wastes that are source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment if exposure occurs. Conversely, non-principal threat wastes are source materials that generally can be reliably contained and that would present only a low risk in the event of exposure.

As discussed in previous sections, the OU1 source units have undergone several physical and chemical treatments in order to reduce the principal threats. The Sludge Lagoon underwent solidification to immobilize the principal threat wastes. The rest of the LF04 waste mass was not treated due to costs and the uncertainty of contents. Institutional controls/LUCs were necessary for OU1 since containment and not treatment was selected as the remedy.

It should be noted that contaminated groundwater is generally not considered to be a source material unless NAPLs are present. For OU3 (groundwater), there are no principal threat wastes as NAPLs have not been detected at the NPL Site.

2.12 SELECTED REMEDY

The Selected Remedy for OU1 is containment based on presumptive remedies for landfills. Stabilization was completed for the most contaminated part of OU1 (Sludge Lagoon). For containment, a cap was installed over OU1 (LF04 and the Sludge Lagoon) in order to reduce infiltration into the waste mass area. The Selected Remedy for OU1 is no further action with institutional controls/LUCs. At the NPL Site, the preferred alternative for OU3 (groundwater) is "Optimized Operation of the Existing OU3 Interim Action groundwater extraction system with institutional controls/LUCs and a pending transition to MNA, when appropriate" (Alternative 3b). The subsections below discuss in more detail the Selected Remedy.

2.12.1 Operable Units 1 and 3 Land Use Controls

As used herein, the term "land use control" or "LUC" means "any restriction or control arising from the need to protect human health and the environment that limits the use of and/or exposure to environmentally contaminated media (e.g. soils, surface water, ground water) at any site on Robins AFB." The term includes controls on access (e.g., engineered and non-engineered mechanisms such as fences,

caps, and security guards). Additionally, the term may encompass both affirmative measures to achieve the desired control (e.g., night lighting of an area) as well as prohibitive directives (e.g., site specific limitations on digging). Finally, the term could also include "institutional controls" that are non-engineered mechanisms for ensuring compliance with necessary land use limitations.

The LUC Objective for OU1 is to protect human health and the environment by preventing direct contact with contaminated soil and solidified sludge under the engineered landfill cover. The LUC Objective for OU3 is to protect human health and the environment by preventing direct contact with, or consumption of, contaminated groundwater (OU3) by maintaining the integrity of the engineered landfill cover and restricting access to the groundwater. Access to the groundwater may be permitted for purposes of further optimizing the groundwater extraction system. Maintenance of the engineered landfill cover includes preventing excavation activities associated with development and any incompatible land uses. For both OU1 and OU3, the LUC objectives prohibit the development and use of property for residential housing, elementary and secondary schools, child care facilities, and playgrounds. The Air Force shall be responsible for implementing, inspecting, reporting on, and enforcing the LUCs described in this ROD. The LUCs will be maintained until the concentration of hazardous substances in the soil (OU1) and the groundwater (OU3) beneath have been reduced to levels that allow for unlimited exposure and unrestricted use.

Figure 23 indicates where the LUCs are located within the OU1 and OU3 areas. Institutional controls being implemented include the following:

a. Conduct quarterly visual inspections of OU1 where LUCs are implemented for the purpose of verifying that all necessary LUCs have been implemented and are being properly maintained;
b. Notify the US EPA and the GA EPD as soon as practicable, but no later than 10 days after discovery of any activity that is inconsistent with the LUC objectives, or use restrictions, or any action that may interfere with the effectiveness of the LUCs. Any activity that is inconsistent with the LUC objectives, or use restrictions, or any action that may interfere with the effectiveness of the LUCs will be addressed by Robins AFB as soon as practicable, but in no case will the notification process be initiated later than 10 days after Robins AFB becomes aware of the activity. Robins AFB will notify the US EPA and the GA EPD regarding how Robins AFB has, or will, address the inconsistent activity within 10 days of sending the US EPA and the GA EPD notification of the activity;

c. Prepare and forward an annual report to the US EPA and the GA EPD by June 1 of each year, on the status of the LUCs, including the operation and maintenance, and monitoring thereof, and how any LUC deficiencies or inconsistent uses have been addressed. Although the report would not be subject to approval and/or revision by the US EPA and the GA EPD, the Air Force agrees to consider and discuss any comments submitted by the US EPA and the GA EPD;

d. Notify the US EPA and the GA EPD at least 60 days in advance of any Base proposals for a major land use change at a site inconsistent with the use restrictions and assumptions described herein, any anticipated action that may disrupt the effectiveness of the LUCs, or any action that might alter or negate the need for LUCs or associated actions. Such changes cannot be implemented without the US EPA and the GA EPD concurrence;

e. Notify the US EPA and the GA EPD, consistent with CERCLA 120(h), at least six (6) months prior to any transfer or sale of OU1, including transfers to private, State or local entities, so that the US EPA and the GA EPD can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective institutional controls. If it is not possible for the installation to notify the US EPA and the GA EPD at least six months prior to any transfer or sale, then Robins AFB will notify the US EPA and the GA EPD as soon as possible but no later than 60 days prior to the transfer or sale of any property subject to institutional controls. Robins AFB shall provide the US EPA and the GA EPD a copy of the executed deed upon request. In addition to the land transfer notice and discussion provisions above, Robins AFB further agrees to provide the US EPA and the GA EPD with similar notice, within the same time frames, as to Federal-to-Federal transfer of property accountability and administrative control of OU1;

f. Submittal to the local zoning authority, or the authority with jurisdiction over local land use, a survey plat indicating the location and dimensions of the LF04 and the Sludge Lagoon source units (OU1) with respect to permanently surveyed benchmarks. This plat will be prepared by a professional land surveyor certified in the State of Georgia. The plat, included as part of the Base Comprehensive Plan and filed with the local zoning authority or the authority with jurisdiction over local land use, will contain a note, prominently displayed, that provides notice of the installation's obligation while the Air Force owns the land, to restrict disturbance of OU1 in accordance with this ROD (e.g., restriction of development construction that would breach the integrity of the engineered landfill cover). Filing of the survey plat is for notice purposes only and is not intended, nor does it create, any property interest;

g. Robins AFB will ensure internal procedures are in place that demonstrate person(s) knowledgeable regarding any use restrictions associated with LUCs review and approve all proposed ground disturbing activities, including any well drilling within the source unit areas. Robins AFB will employ administrative procedures to track all development activity that requires excavation to ensure that no project violates LUC restrictions for the NPL Site. Air Force Environmental Management personnel will coordinate and approve all proposed projects located on or near the NPL Site in accordance with Air Force instructions and procedures. Existing procedures require the Environmental Management to review and coordinate all Base civil engineering work requests and to coordinate the "Dig Permit" request process for reviews and approvals prior to initiating any "ground breaking" work. Through these review and approval mechanisms, the Air Force will ensure that these or similar instructions, processes, and/or requirements will be complied with for all proposed construction or surface soil disturbing activities at the NPL Site;

h. Maintenance of a gate at each entry point to OU1 (LF04 and the Sludge Lagoon source units) in order to restrict access. It is considered that in order for any human contact to occur with the LF04 and the Sludge Lagoon source units (waste mass), heavy equipment would be necessary. In this case, heavy equipment would be required to gain access to OU1 through the two secure gate access and egress locations indicated on Figure 23. These gates effectively control unauthorized access to the NPL Site that could result in likely exposure to COCs;

i. Maintenance of signage (1) at each entrance to the LF04 and the Sludge Lagoon source units (OU1) and (2) at other locations in sufficient numbers to be seen from any likely approach to OU1. The signs will read "Former Landfill - Authorized Personnel Only – Contact Environmental Management Regarding Land Use Restrictions" and the current Environmental Management contact phone number will be displayed. Signs will be posted within 90 days of obtaining all signatures for the ROD. Signage lettering will be legible from a distance of at least 25 feet; and

j. Prohibition of water supply wells within OU3 (i.e. groundwater contaminated by the LF04 and the Sludge Lagoon source units).

2.12.2 Summary of Rationale for the Selected Remedy

2.12.2.1 Operable Unit 1 (LF04 and WP14 Sludge Lagoon)

For OU1, the Selected Remedy (presumptive remedy for landfills), as described in the OU1 IROD (IRP, 1991), was containment. As outlined in the ISA (Robins AFB, 1998), any further treatment of the landfill (LF04) waste mass was not recommended due to the high cost of further treatment or removal and the uncertainty of the contents within LF04. Because containment was chosen for LF04 as a presumptive remedy, no other alternatives were presented in the FS or PP for OU1. No Further Action with LUCs has been proposed as part of this ROD to restrict exposure to remaining contamination and to limit land use.

2.12.2.2 Operable Unit 3 (Groundwater)

As outlined in Table 11, Alternative 3b achieves the desired outcome with minimal tradeoffs with respect to balancing and modifying criteria. Through groundwater modeling conducted during the 1999 FS, it was determined that other alternatives, which included more aggressive remediation, did not necessarily decrease the time to achieve cleanup. Alternative 3b is protective of human health and the environment, should comply with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, and is cost effective. Metal COCs appear to be relatively immobile even under the influence of extraction systems. However, recent data indicates decreasing trends in metal concentrations, likely attributed to natural attenuation mechanisms, and also decreasing trends in VOC concentrations (Table 3 and Earth Tech, 2003). Groundwater monitoring would be used concurrently with and subsequent to this remedy to verify the immobility of the metals and the reduction in their concentrations through natural attenuation mechanisms, and to evaluate the reductions in VOC concentrations. When the evaluation of the data for two groundwater sampling events indicate that the continued operation of the system is less efficient and effective than MNA, documentation will be provided by the Air Force to the US EPA and GA EPD to justify the technical decision for turning off the groundwater extraction system and transitioning to MNA. The supporting data may include the analytical results, isoconcentration maps, contaminant trend analyses, groundwater extraction rate data, contaminant mass removal data, system operating costs, and revised groundwater and transport modeling, as applicable. The supporting data will sufficiently document the groundwater treatment system's efficiency and effectiveness. This evaluation, subject to the US EPA and GA EPD review and approval, will allow for deactivating the OU3 groundwater extraction system and transitioning to MNA when it is determined that MNA is the most appropriate remedial strategy. This remedy utilizes permanent solutions and treatment to the maximum extent practical for the NPL Site.

2.12.3 Description of Selected Remedy

2.12.3.1 Operable Unit 1 (LF04 and WP14 Sludge Lagoon)

Based on the ISA in 1998, a presumptive remedy for OU1 (landfill capping) was chosen and implemented prior to developing the FS for the NPL Site. The interim actions listed below are now considered final remedial actions and include the following:

- Initial clay capping of the Sludge Lagoon with a clayey sand cover;
- In situ volatilization of the Sludge Lagoon waste mass;
- Excavation of the Sludge Lagoon waste mass and solidification;
- LF04 cover renovation using geosynthetic fabric and clay liner;
- Installation of gas collection system at LF04;
- Construction of a new cover over LF04 and the Sludge Lagoon;
- Construction of a run-on diversion structure around LF04;
- Installation of a leachate collection system at LF04; and
- Institutional controls to restrict access and future site use.

Institutional controls are a major component of the Selected Remedy for OU1 and are presented in detail in Section 2.12.1.

2.12.3.2 Operable Unit 3 (Groundwater)

Under this alternative, the OU3 Interim Action groundwater extraction system would be optimized by maximizing the removal of contaminants more cost effectively, eventually deactivating the system, and subsequently transitioning to MNA. The OU3 groundwater extraction system currently operating would capture elevated levels of contaminants while allowing residual contaminants not captured by the system to be reduced by natural attenuation mechanisms. Groundwater would be monitored concurrently and subsequently to implementation of this alternative to verify the reduction in contaminant concentrations and the effectiveness of natural attenuation mechanisms.

The optimized OU3 Interim Action groundwater extraction system would consist of initially operating the OU3 groundwater extraction system at a rate of approximately 50 gpm each. Through operation of the OU3 groundwater extraction system, most of the organic contamination and some metals will be captured, thus inhibiting a portion of contaminants in groundwater from potentially discharging to the

wetlands, surface water, and sediments. As part of the remedy, the effectiveness of the OU3 groundwater extraction system will be evaluated. When groundwater data indicates that the continued operation of the OU3 groundwater extraction system provides no appreciable benefit over MNA, the system will be turned off and transitioned to MNA. This evaluation, subject to the US EPA and GA EPD review and approval, will allow for deactivating the OU3 groundwater extraction system and transitioning to MNA when it is determined that MNA is the most appropriate remedial strategy.

Based on contaminant transport modeling performed in 2003 (Earth Tech, 2004), it is estimated that cleanup to chemical and location-specific ARARs could occur in a significantly shorter period of time (possibly less than 10 years) than previously estimated in the FS (30 years) (Earth Tech/Rust E&I, 1999a). The chemical-specific ARAR for the NPL Site OU3 is meeting MCLs that should be attained for VOCs as indicated by groundwater modeling. It is expected that the Selected Remedy will decrease metals concentrations in OU3 to attain MCLs through MNA mechanisms. There are two location-specific ARARs: (1) Georgia WQS standards for the wetlands surface water resulting from the natural discharge of OU3 groundwater, and (2) the protection of floodplains and threatened and/or endangered species. The Selected Remedy should meet both these ARARs. The action-specific ARARs for the Selected Remedy (adherence to the preexisting NPDES permit requirements) has been met with the current OU3 Interim Action groundwater extraction system. The ARARs should be met in the future with the optimized OU3 groundwater extraction system because the GWTS is designed to treat the levels of contamination expected from the optimized system.

Limiting the future use of the site (land and groundwater) through institutional controls is a major component of the Selected Remedy for OU3. These institutional controls are presented in detail in Section 2.12.1.

2.12.4 Summary of Estimated Remedy Costs

To date, over $10 million has been spent on containment of OU1. Future costs associated with implementing LUCs are estimated to be approximately $160,000 (30 year scenario) because institutional controls are already in place and O&M of such controls would be minimal.

Total “present worth” costs for the Selected Remedy for OU3 are estimated to be between $7,042,000 for an estimated 10 year operating period (10 year scenario) and $12,059,000 for an estimated 30 year operating period (30 year scenario). Table 12 includes a more detailed analysis of costs associated with

the preferred alternative. Capital costs include a remedial design/groundwater optimization evaluation in both the scenarios. Annual O&M costs include treatment plant operators, sampling, groundwater data evaluation, and remedy review. The US EPA guidance suggests that costs are to be presented in terms of "present worth" in the ROD. Table 12 presents the costs associated with the preferred alternative using "present worth" in the economic analysis. However, it should be noted that a different economic analysis using "escalated costs", which includes costs factored for inflation over time, was presented in both the FS (Earth Tech/Rust E&I, 1999a) and the PP (Earth Tech/Rust E&I, 1999b). Table 13 includes the costs associated with the remedial alternatives using "escalated costs" in the economic analyses, as presented in the FS and the PP. Therefore, due to the use of the two different economic analyses for the preferred alternative, the cost estimates presented in this ROD and in the FS and the PP are not directly comparable (Table 12 and Table 13).

2.12.5 Expected Outcomes of the Selected Remedy

The expected outcome for the Selected Remedy in terms of resulting land and groundwater uses and risk reduction achieved as a result of the response action is discussed below. The Selected Remedy for OU1 is containment that does not include a time frame to achieve cleanup levels. LUCs are to be implemented that will designate the NPL Site as non-residential in the Base Master Plan. By capping the LF04 and the Sludge Lagoon source units (OU1), infiltration to the source units has been eliminated, and contaminants leaching to the OU3 groundwater and potentially to surface water have been reduced. Therefore, there are ecological benefits as a result of implementing containment for OU1.

As discussed in previous sections of this ROD, the RAOs for groundwater (OU3) at the NPL Site are containment and reduction of contaminants to below MCLs. It is anticipated that groundwater at the NPL Site will be remediated to the RAOs and that it may be used for drinking water purposes in the future. However, it should be noted that although the State considers all groundwater potential drinking water, potable wells have traditionally been installed in the deeper Blufftown aquifer that currently does not contain COCs related to the NPL Site. It is expected that the Blufftown aquifer will continue to remain free of COCs throughout the life of the Selected Remedy. It is expected that cleanup of all aquifers will continue until contaminant levels are below MCLs through treatment and/or natural attenuation mechanisms.

Based on recent groundwater modeling completed during 2003 (Earth Tech, 2004d), the estimated time for cleanup could occur in a significantly shorter period of time (possibly less than 10 years) than

previously estimated in the FS (30 years) (Earth Tech/Rust E&I, 1999a). Upon completion of cleanup, groundwater would be available for limited use, although as explained above, potable water is typically obtained from the Blufftown aquifer, which does not currently contain any COCs related to the NPL Site. As with OU1, cleanup of the groundwater would reduce the potential for groundwater contamination to enter the surface water, which provides an ecological benefit to the wetlands downgradient of the NPL Site.

2.13 STATUTORY DETERMINATIONS

The focus of this ROD is to attain the remedial objectives established. Based on the information currently available, the USAF and the US EPA in conjunction with the GA EPD believe the selected OU3 (groundwater) remedy (*Alternative 3b: Optimized Operation of the Existing OU3 Interim Action*) meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. Robins AFB expects the Selected Remedy to satisfy the following statutory requirements of CERCLA §121(b): (1) be protective of human health and the environment, (2) comply with ARARs, (3) be cost effective, (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and (5) satisfy the preference for treatment as a principal element. Table 13 provides a decision matrix for the comparison of alternatives that summarizes the ability of each alternative to achieve the statutory requirements. The following sections discuss how the Selected Remedy meets these statutory requirements.

2.13.1 Protection of Human Health and the Environment

The RAOs for OU1 are containment and institutional controls/LUCs. Maintenance of the cap on the LF04 and the Sludge Lagoon source units (OU1) and implementing institutional controls/LUCs will ensure that all exposure pathways for OU1 are incomplete and/or insignificant. A reevaluation of the risk remaining at OU1 will be completed during one of the five year reviews or at the time that OU3 (groundwater) is deemed remediated to acceptable levels. It should be noted that the Selected Remedy would not pose unacceptable short-term risks or cross-media contamination.

The RAOs for OU3 are also containment with institutional controls/LUCs and reduction of contaminants to below MCLs. The Selected Remedy will be protective of human health and the environment through the optimized OU3 groundwater extraction and treatment remediation system. MCLs are the chemical-

specific ARARs that will be met once the groundwater remediation is complete. The exposure pathways for OU3 groundwater are through ingestion, inhalation, and dermal contact under a future resident scenario. There are no complete exposure pathways for ecological receptors (current or future). Since MCLs are the chemical-specific ARARs for OU3, protection of the environment would be accomplished because MCLs are inherently protective of human health and the environment. This would ensure that all COCs for OU3 are remediated to within the US EPA's acceptable range of 10^{-4} to 10^{-6} for carcinogenic risk and below the HI of 1 for non-carcinogens. Until MCLs have been achieved, LUCs will ensure exposure pathways for OU3 groundwater will remain incomplete. Implementation of the Selected Remedy will not pose unacceptable short-term risks or cross-media impacts.

2.13.2 Compliance with Applicable or Relevant and Appropriate Requirements

The Selected Remedy for OU3 will comply with all ARARs. A detailed discussion of ARARs is found in the FS (Earth Tech/Rust E&I, 1999a). Table 14 presents a detailed description of all ARARs.

2.13.3 Cost Effectiveness

In the lead agency's judgment, the Selected Remedy for OU3 has been determined to provide overall effectiveness proportional to its costs. Alternative 3b is protective of human health and the environment, should comply with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, and is cost effective. This remedy utilizes permanent solutions and treatment to the maximum extent practical to reduce the toxicity, mobility, and volume of contaminants for the NPL Site. The estimated present worth cost of the Selected Remedy (Alternative 3b) is between $7,042,000 (10 year scenario) and $12,059,000 (30 year scenario). Although Alternatives 1 and 2 are less expensive than either of the Selected Remedy cost scenarios, Alternative 1 is not protective of human health and the environment and Alternative 2 does not provide a permanent solution. Alternative 3a is less expensive than the 30 year cost scenario for the Selected Remedy, however, Alternative 3a may leave a higher residual risk while also not supplying the greater reduced volume and toxicity of contaminated groundwater.

2.13.4 Use of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable

Of the alternatives that are protective of human health and the environment and comply with ARARs, the USAF has determined that the Selected Remedy provides the best balance of tradeoffs in terms of long-

term effectiveness and permanence; reduction in toxicity, mobility, or volume achieved through treatment; short-term effectiveness; implementability; and cost while also considering the statutory preference for treatment as a principal element and considering State and community acceptance. The Selected Remedy is considered to be a permanent solution for both OU1 and OU3.

2.13.5 Preference for Treatment as a Principal Element

Containment with institutional controls/LUCs and not treatment was chosen as the final Selected Remedy for OU1. Containment was chosen because it is not cost effective to remove and treat a 45-acre landfill.

Containment with institutional controls/LUCs was also chosen for OU3 (groundwater). The OU3 groundwater treatment system will provide containment of the groundwater through the extraction, treatment, and eventual discharge of the effluent to a preexisting NPDES permitted outfall, until the transition to MNA occurs.

2.13.6 Five Year Review Requirements

The NCP §300.430(f)(4)(ii) requires a five year review if the remedial action results in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. Because containment was selected as a presumptive remedy for OU1, institutional controls/LUCs are selected in this ROD to compensate for contaminants that remain in the LF04 waste mass. Therefore, a five year "statutory review" will be required pursuant to CERCLA §121(c) and NCP §300.430(f)(5)(iii)(C) no less often than every five years until on-site contaminant levels allow for unlimited use and unrestricted exposure. The first five year review for OU1 will be submitted no later than five years from final acceptance of this ROD. For OU3, it is estimated that the Selected Remedy will reduce contaminant levels to below MCLs in 30 years or less. Therefore, a five year "statutory review" will be required pursuant to CERCLA §121(c) and NCP §300.430(f)(5)(iii)(C) no less often than every five years until on-site contaminant levels allow for unlimited use and unrestricted exposure. The first five year review for OU3 will be submitted no later than five years from final acceptance of this ROD.

2.14 DOCUMENTATION OF SIGNIFICANT CHANGES FROM PREFERRED ALTERNATIVE OF PROPOSED PLAN

2.14.1 Operable Unit 1

To fulfill CERCLA §117(b) and NCP §300.430(f)(5)(iii)(B) and §300.430(f)(3)(ii)(A), this ROD must document and discuss the reasons for any significant changes to the Selected Remedy. Although there were no changes to the Selected Remedy as a result of the public comment period for the PP, it should be noted there was an extended period between when the PP was issued for public comment in November of 1999 and finalization of this ROD. This delay was due to a national policy dispute that developed in 2001 between the Department of Defense and the US EPA Headquarters regarding post-ROD authorities. In late 2003, both agencies issued agreed-upon guidance to their respective field offices directing a patterned approach to resolve this dispute. Importantly, the dispute did not substantively affect the Selected Remedy and has only marginally changed the content of this ROD with the addition of specific language from the MOA on LUCs entered into by the USAF, the US EPA Region IV, and the GA EPD in 2001. Finally, because (1) the PP only addressed LUCs generally and (2) these same LUCs continue to be part of the Selected Remedy, the US EPA Region IV and the GA EPD agree that no additional discussion is warranted for purposes of satisfying NCP 300.430(f)(3)(ii).

2.14.2 Operable Unit 3

The PP (Earth Tech/Rust E&I, 1999b) identified the remedial strategy as Alternative 3b, to optimize the OU3 Interim Action groundwater extraction system as presented in the OU3 IROD (IRP, 1995b). Since 1999, significant reductions in contaminant concentrations have occurred as a result of implementation and optimization of the selected IROD remedy for OU3. The contaminant plume concentrations have been reduced, thereby, allowing for approvals from the US EPA and the GA EPD to discontinue operation of four of the six OU3 extraction wells. In addition, the leachate and pump stations for the LF04 toe drain were deactivated in 2002 with prior regulatory approval. The 2003 Annual Progress Report (Earth Tech, 2004) includes trend plots for TCE that show a downward contaminant concentration trend for the two OU3 extraction wells currently being pumped. Based on that trend and the data presented in Table 3, it is anticipated that in the near future, the evaluation of supporting data will indicate that the continued operation of the system is less efficient and effective than MNA. This evaluation, subject to the US EPA and GA EPD review and approval, will allow for deactivating the OU3 groundwater extraction system and transitioning to MNA when it is determined that MNA is the most appropriate remedial strategy.

3.0 RESPONSIVENESS SUMMARY

The responsiveness summary is intended to provide information about the views of the public and support agency regarding both the remedial alternatives and general concerns about the site submitted during the public comment period. The public comment period and public meeting produced several questions as discussed below. However, the questions and responses did not affect the Selected Remedy.

During the public comment period, there were no written comments on the PP received from the public. A public meeting was held on February 10, 2000, to present the PP and the preferred alternative to the community. Several verbal questions were received from one person during the public meeting. The questions and responses are as shown below. Please note that some of the questions and responses listed below have been paraphrased for clarity.

Question: What is the timeline for implementation?

Response: The groundwater extraction system has been in operation since October 1997 so in essence, implementation has already occurred. Once the ROD has been accepted, work can begin on optimizing the groundwater system. This will require additional modeling and possibly adjusting the current system. It is anticipated that this can be accomplished in approximately six months from acceptance of this ROD.

Question: What is the sunset date, or do you have any idea when we are talking about completing this?

Response: Based upon groundwater modeling completed during the 1999 FS, the estimated time to cleanup this site is less than 30 years. Most of the contamination would be removed in the first 10 years with metals taking the longest to reach MCLs. As pointed out earlier in this document, it may not be feasible to remediate metals contamination in the surficial aquifer (OU1 waste mass).

Question: How about public concern? Like myself, many people may wonder what would take so long and are we on track with it. And, so, how do we keep the public adequately apprised and adequately reassured that remediation is in progress?

Response: Under the current structure there has to be a minimum of a five year review as long as the site is undergoing remedial action. So every five years Robins AFB would have to go

back and review the Selected Remedy to see if it is working, and if it's not, see what needs to change to meet the remedial action objections. Prior to finalizing the five year review, Robins AFB would go out with fact sheets and brief members on the Restoration Advisory Board on the progress. Robins AFB would give the regulatory agencies periodic copies of what the sampling results are.

Question: Would the public be notified of the five year reviews through media outlets?

Response: Yes, through newspaper print ads and the community relations plan.

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Table 1
Prevalent Chemicals Found in Source Area OU1 During Remedial Investigation
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Source Area	Chemical of Concern	Maximum Level Detected (µg/L)[1]	MCL (µg/L) as of October 1996[2]	MCL (µg/L) as of Summer 2000[3]	Type and Characteristic[4]
WP14 Sludge Lagoon	Arsenic	21,000	50	5	I,C
WP14 Sludge Lagoon	Cadmium	34,800	5	5	I,N
WP14 Sludge Lagoon	Chromium	13,163,000	100	100	I,N
WP14 Sludge Lagoon	Copper	10,600	1300 (TT[5])	1300 (TT[5])	I,N
WP14 Sludge Lagoon	Lead	60,000	15 (TT[5])	15 (TT[5])	I,*
WP14 Sludge Lagoon	Mercury	85	2	2	I,*
WP14 Sludge Lagoon	Nickel	15,000	100	NA	I,N
WP14 Sludge Lagoon	1,1-Dichloroethene	100	7	7	M,N
WP14 Sludge Lagoon	1,2-Dichlorobenzene	28,000	600	600	M,N
WP14 Sludge Lagoon	cis-1,2-Dichloroethene	36,000	70	70	M,N
WP14 Sludge Lagoon	1,4-Dichlorobenzene	13,000	75	75	M,C
WP14 Sludge Lagoon	Benzene	660	5	5	M,C
WP14 Sludge Lagoon	Chlorobenzene	4,000	100	100	M,N
WP14 Sludge Lagoon	Methylene Chloride	6,000	5	5	M,C
WP14 Sludge Lagoon	Tetrachloroethene	1,100	5	5	M,C
WP14 Sludge Lagoon	Toluene	2,200	1,000	1,000	M,N
WP14 Sludge Lagoon	Trichloroethene	130,000	5	5	M,C
WP14 Sludge Lagoon	Vinyl Chloride	12,000	2	2	M,C
Landfill No. 4	Arsenic	13,000	50	5	I,C
Landfill No. 4	Cadmium	9,300	5	5	I,N
Landfill No. 4	Chromium	66,000	100	100	I,N
Landfill No. 4	Copper	3,600	1300 (TT[5])	1300 (TT[5])	I,N
Landfill No. 4	Lead	10,400	15 (TT[5])	15 (TT[5])	I,*
Landfill No. 4	Mercury	880	2	2	I,*
Landfill No. 4	Nickel	1,300	100	NA	I,N
Landfill No. 4	1,4-Dichlorobenzene	120	75	75	M,N
Landfill No. 4	Benzene	85	5	5	M,C
Landfill No. 4	Chlorobenzene	150	100	100	M,N
Landfill No. 4	Methylene Chloride	110	5	5	M,C
Landfill No. 4	Trichloroethene	8	5	5	M,C
Landfill No. 4	Vinyl Chloride	12	2	2	M,C

Notes:

µg/L = micrograms per liter
MCL = maximum contaminant level
TT =Treatment Technique
NA = Not Applicable (MCL not available for this chemical)
I = immobile; M = mobile; C = carcinogenic; N = noncarcinogenic; * = data not available

[1] Chemicals of Concern for the Sludge Lagoon and LF04 are prior to any interim actions and are based on 1990 data collected and reported by CH2MHill from leachate and surficial well samples.

[2] Chemical-specific groundwater MCLs based on Drinking Water Regulations and Health Advisories, EPA 822-B-96-002 (US EPA, October 1996) EXCEPT FOR Lead and Copper which are "at tap" action levels (see note 5 below). The 1996 MCL values were used in the development of the COCs, FS, and final remedy selection.

[3] Chemical-specific groundwater MCLs based on Drinking Water Regulations and Health Advisories, EPA 816-F-03-016 (US EPA, Summer 2003) EXCEPT FOR Lead and Copper which are "at tap" action levels (see note 5 below).

[4] Based on groundwater modeling completed during the FS (Earth Tech/Rust E & I, February 1999), metals in the surficial aquifer are generally immobile; carcinogenity based upon US EPA Region 3 Risk-Based Concentration (RBC) Table, Tap Water (US EPA, April 2000).

[5] Copper "at tap" action level is 1300 µg/L; Lead "at tap" action level is 15 µg/L.

Table 2
Summary of Chemicals of Concern for OU3 Groundwater
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Aquifer (unit)	Chemical of Concern	Maximum Detected (µg/L)[1]	MCL (µg/L) as of October 1996[2]	MCL (µg/L) as of Summer 2003[3]	Type and Characteristic[4]
Surficial	Arsenic	394	50	5	I, C
Surficial	Cadmium	45.3	5	5	I,N
Surficial	Chromium	57.3	100	100	I,N
Surficial	Lead	113	15 (TT[5])	15 (TT[5])	I,*
Surficial	Benzene	100	5	5	M,C
Surficial	Chlorobenzene	450	100	100	M,N
Surficial	cis-1,2-Dichloroethene	1,300	70	70	M,N
Surficial	Tetrachloroethene	54	5	5	M,C
Surficial	Trichloroethene	590	5	5	M,C
Quaternary	Carbon Tetrachloride	38	5	5	M,C
Quaternary	Chlorobenzene	850	100	100	M,N
Quaternary	Tetrachloroethene	150	5	5	M,C
Quaternary	Trichloroethene	840	5	5	M,C
Quaternary	Vinyl chloride	170	2	2	M,C
Upper Providence	Carbon Tetrachloride	38	5	5	M,C
Upper Providence	Tetrachloroethene	150	5	5	M,C
Upper Providence	Trichloroethene	840	5	5	M,C

Notes:
µg/L = micrograms per liter MCL = maximum contaminant level
TT =Treatment Technique
I = immobile; M = mobile; C = carcinogenic; N = noncarcinogenic; * = data not available

[1] Maximum detected concentration of chemical in groundwater samples based upon Spring 1998 basewide groundwater sampling event data (Rust E&I, 1998).

[2] Chemical-specific groundwater MCLs based on Drinking Water Regulations and Health Advisories, EPA 822-B-96-002 (US EPA, October 1996) EXCEPT FOR Lead which is an "at tap" action level (see note 5 below). The 1996 MCL values were used in the development of the COCs, FS, and final remedy selection.

[3] Chemical-specific groundwater MCLs based on Drinking Water Regulations and Health Advisories, EPA 816-F-03-016 (US EPA, Summer 2003) EXCEPT FOR Lead which is an "at tap" action level (see note 5 below).

[4] Based on groundwater modeling completed during the FS (Earth Tech/Rust E & I, February 1999), metals in the surficial aquifer are generally immobile; carcinogenity based upon US EPA Region 3 Risk-Based Concentration (RBC) Table, Tap Water (US EPA, April 2000).

[5] Lead "at tap"action level is 15 µg/L.

Table 3
Current Concentrations for Chemicals of Concern for OU3 Groundwater
Comparison to MCLs and Historic Concentrations
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Aquifer (unit)	Chemical of Concern	Maximum Detected Concentration (µg/L)		Well ID [3]	MCL (µg/L) as of Summer 2003 [4]
		Spring 1998 [1]	Spring 2003 [2]		
Surficial	Arsenic	394	102	LSB15	5
Surficial	Cadmium	45.3	0.38 J	LF4-44	5
Surficial	Chromium	57.3	14.2	LSB15	100
Surficial	Lead	113	6.85	LSB15	15 (TT[5])
Surficial	Benzene	100	76	LSB13	5
Surficial	Chlorobenzene	450	210	LSB14	100
Surficial	cis-1,2-Dichloroethene	1300	ND	-	70
Surficial	Tetrachloroethene	54	0.14 J	LF4-28	5
Surficial	Trichloroethene	590	0.19 J	LF4-28	5
Quaternary	Carbon Tetrachloride	38	25	LF4-30	5
Quaternary	Chlorobenzene	850	1100	LF4-6	100
Quaternary	Tetrachloroethene	150	55	LF4WP9	5
Quaternary	Trichloroethene	840	160	LF4-6	5
Quaternary	Vinyl Chloride	170	270	LF4-6	2
Upper Providence	Carbon Tetrachloride	38	73	RI1-2W	5
Upper Providence	Tetrachloroethene	150	190	RI1-2W	5
Upper Providence	Trichloroethene	840	490	RI1-2W	5

Notes:

µg/L = micrograms per liter
MCL = maximum contaminant level
TT = treatment technique
ND = not detected
J = estimated concentration
- = not applicable

[1] Maximum detected concentration of chemical in groundwater samples based upon Spring 1998 basewide groundwater sampling event data (Rust E&I, 1998).

[2] Maximum detected concentration of chemical in groundwater samples based upon Spring 2003 basewide groundwater sampling event data (Earth Tech, 2003).

[3] Well IDs apply to the Spring 2003 concentrations.

[4] Chemical-specific groundwater MCLs based on Drinking Water Regulations and Health Advisories, EPA 816-F-03-016 (US EPA, Summer 2003) EXCEPT FOR Lead which has an "at tap" action level (see note 5 below).

[5] Lead "at tap" action level is 15 µg/L.

Table 4
Summary of Chemicals of Concern and
Medium-Specific Exposure Point Concentrations - Groundwater[1]
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins Air Force Base, Georgia

Scenario Timeframe:	Future
Medium:	Groundwater [2]
Exposure Medium:	Groundwater and Water Vapors [2]

Exposure Point	Chemical of Concern[3]	Concentration Detected [4]			Units	Frequency of Detection [5]	Exposure Point Concentration [6]	Exposure Point Concentration Units	Statistical Measure [6]
		Minimum	Maximum	Mean					
On-Site Resident	VOCs								
	Benzene	2.00E+00	2.00E+00	2.00E+00	µg/L	5%	NA	NA	NA
Quaternary Alluvial Aquifer	Butanone, 2-	2.50E+01	1.10E+02	5.24E+01	µg/L	5%	NA	NA	NA
Ingestion and	Carbon tetrachloride	1.00E+00	7.00E+01	1.00E+01	µg/L	60%	NA	NA	NA
Inhalation of Water Vapors [7]	Chlorobenzene	2.00E+00	1.00E+01	5.90E+00	µg/L	17%	NA	NA	NA
	Chloroform	1.00E+00	1.90E+02	6.90E+00	µg/L	60%	NA	NA	NA
	Dichlorobenzene, 1,2-	4.00E+00	5.00E+00	4.60E+00	µg/L	7%	NA	NA	NA
	Dichlorobenzene, 1,4-	4.00E+00	8.00E+00	6.70E+00	µg/L	10%	NA	NA	NA
	Dichloroethene, 1,2-	2.00E+00	3.40E+01	8.60E+00	µg/L	55%	NA	NA	NA
	Dichloropropene, trans-1,3-	5.00E+00	5.00E+00	5.00E+00	µg/L	2%	NA	NA	NA
	Tetrachloroethene	1.00E+00	3.30E+02	9.70E+00	µg/L	57%	NA	NA	NA
	Trichloroethane, 1,1,1-	1.00E+00	1.00E+00	1.00E+00	µg/L	2%	NA	NA	NA
	Trichloroethene	1.00E+00	5.90E+02	3.92E+01	µg/L	91%	NA	NA	NA
	Vinyl chloride	1.00E+00	1.00E+00	1.00E+00	µg/L	2%	NA	NA	NA
	PAHs								
	Dimethylphenol, 2,4-	ND	ND	ND	µg/L	ND	NA	NA	NA
	Methylphenol, 2-	ND	ND	ND	µg/L	ND	NA	NA	NA
	Methylphenol, 4-	ND	ND	ND	µg/L	ND	NA	NA	NA
	Metals								
	Aluminum	8.29E+01	5.00E+04	6.17E+03	µg/L	98%	NA	NA	NA
	Arsenic	6.00E-01	1.60E+00	9.00E-01	µg/L	15%	NA	NA	NA
	Beryllium	2.00E-01	2.90E+00	5.00E-01	µg/L	26%	NA	NA	NA
	Cadmium	6.20E+00	1.62E+01	1.00E+01	µg/L	5%	NA	NA	NA
	Copper	3.10E+00	1.68E+02	2.74E+01	µg/L	71%	NA	NA	NA
	Manganese	7.50E+00	4.63E+02	8.88E+01	µg/L	98%	NA	NA	NA
	Mercury	1.00E-01	9.70E+00	8.00E-01	µg/L	45%	NA	NA	NA
	Nickel	1.41E+01	8.33E+01	2.88E+01	µg/L	41%	NA	NA	NA
	Thallium	2.00E+00	2.00E+00	2.00E+00	µg/L	2%	NA	NA	NA
	Vanadium	5.40E+00	1.01E+02	2.54E+01	µg/L	74%	NA	NA	NA
	Pesticides								
	Dieldrin	1.00E-02	3.50E-02	1.70E-02	µg/L	52%	NA	NA	NA

Table 4
Summary of Chemicals of Concern and
Medium-Specific Exposure Point Concentrations - Groundwater[1]
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins Air Force Base, Georgia

Scenario Timeframe:	Future
Medium:	Groundwater [2]
Exposure Medium:	Groundwater and Water Vapors [2]

Exposure Point	Chemical of Concern[3]	Concentration Detected [4]			Units	Frequency of Detection [5]	Exposure Point Concentration [6]	Exposure Point Concentration Units	Statistical Measure [6]
		Minimum	Maximum	Mean					
On-Site Resident	VOCs								
	Bromomethane	1.00E+01	1.00E+01	1.00E+01	µg/L	3%	NA	NA	NA
Upper Providence Unit	Butanone, 2-	1.40E+02	2.90E+02	1.98E+02	µg/L	9%	NA	NA	NA
Ingestion and	Carbon tetrachloride	1.00E+00	1.20E+02	7.40E+00	µg/L	50%	NA	NA	NA
Inhalation of Water Vapors [7]	Chloroform	1.00E+00	1.50E+01	1.60E+00	µg/L	22%	NA	NA	NA
	Dichloroethene, 1,1-	1.00E+00	1.00E+00	1.00E+00	µg/L	3%	NA	NA	NA
	Dichloropropene, trans-1,3-	5.00E+00	5.00E+00	5.00E+00	µg/L	3%	NA	NA	NA
	Tetrachloroethene	1.00E+00	8.50E+01	8.70E+00	µg/L	28%	NA	NA	NA
	Trichloroethane, 1,1,1-	1.00E+00	4.00E+00	2.30E+00	µg/L	9%	NA	NA	NA
	Trichloroethene	1.00E+00	1.20E+03	2.60E+01	µg/L	59%	NA	NA	NA
	PAHs								
	Dinitrophenol, 2,4,-	5.00E+01	5.00E+01	5.00E+01	µg/L	3%	NA	NA	NA
	Metals								
	Arsenic	6.00E-01	1.30E+00	9.00E-01	µg/L	13%	NA	NA	NA
	Beryllium	2.00E-01	7.00E-01	4.00E-01	µg/L	25%	NA	NA	NA
	Cadmium	3.80E+00	1.15E+01	5.30E+00	µg/L	13%	NA	NA	NA
	Thallium	ND	ND	ND	µg/L	ND	NA	NA	NA
	Vanadium	3.20E+00	5.25E+01	1.12E+01	µg/L	53%	NA	NA	NA
	Zinc	7.70E+00	1.07E+02	2.73E+01	µg/L	66%	NA	NA	NA
	Pesticides								
	Dieldrin	1.10E-02	6.80E-02	2.60E-02	µg/L	38%	NA	NA	NA
On-Site Resident	VOCs								
	Bromomethane	1.00E+01	1.00E+01	1.00E+01	µg/L	5%	NA	NA	NA
Lower Providence Unit	Dichloropropene, trans-1,3-	5.00E+00	5.00E+00	5.00E+00	µg/L	5%	NA	NA	NA
Ingestion and	Trichloroethene	1.00E+00	1.00E+01	2.40E+00	µg/L	30%	NA	NA	NA
Inhalation of Water Vapors [7]									
	PAHs								
	Dinitrophenol, 2,4-	5.00E+01	5.00E+01	5.00E+01	µg/L	5%	NA	NA	NA
	Metals								
	Arsenic	6.00E-01	8.00E-01	7.00E-01	µg/L	17%	NA	NA	NA
	Beryllium	1.00E-01	5.00E-01	3.00E-01	µg/L	30%	NA	NA	NA
	Cadmium	4.60E+00	4.60E+00	4.60E+00	µg/L	5%	NA	NA	NA
	Zinc	4.70E+00	5.24E+01	2.14E+01	µg/L	65%	NA	NA	NA
	Pesticides								
	Dieldrin	9.00E-03	5.00E-02	2.60E-02	µg/L	15%	NA	NA	NA

Table 4
Summary of Chemicals of Concern and
Medium-Specific Exposure Point Concentrations - Groundwater[1]
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins Air Force Base, Georgia

Scenario Timeframe:	Future
Medium:	Groundwater [2]
Exposure Medium:	Groundwater and Water Vapors [2]

Exposure Point	Chemical of Concern[3]	Concentration Detected [4]			Units	Frequency of Detection [5]	Exposure Point Concentration [6]	Exposure Point Concentration Units	Statistical Measure [6]
		Minimum	Maximum	Mean					
On-Site Resident	Metals								
	Arsenic	3.00E+00	9.30E+00	4.50E+00	µg/L	23%	NA	NA	NA
Blufftown and Cusseta Aquifer	Beryllium	2.00E-01	2.00E-01	2.00E-01	µg/L	8%	NA	NA	NA
Ingestion [7]	Cadmium	1.03E+01	1.03E+01	1.03E+01	µg/L	8%	NA	NA	NA
	Thallium	ND	ND	ND	µg/L	ND	NA	NA	NA
	Zinc	4.09E+01	7.83E+04	2.77E+02	µg/L	100%	NA	NA	NA

Notes:

[1] - Information presented in this table obtained from Draft Final Remedial Investigation Report for Zone 1, Operable Unit 3: Groundwater, Robins Air Force Base, Warner Robins, Georgia (CH2M Hill, April 1993).

[2] - Potential groundwater and water vapor exposures from hypothetical potable groundwater wells in Quatenary Alluvial/Unconfined Upper Providence, Confined Upper Providence, Lower Providence and Blufftown/Cusseta aquifers.

[3] - Chemicals of Concern (COCs) are identified as those chemicals which significantly contribute to total cancer risk greater than 10^{-6} or total hazard index (HI) greater than 1.

[4] - Concentrations are reported in the BRA based upon minimum, maximum, and geometric mean values for comparison purposes.

[5] - Frequency of detection based upon percent detection of total number of samples.

[6] - Exposure point concentration is based upon the maximum detected concentration (MAX) on a per-well basis, as presented in Table 12.

[7] - Concentrations are based upon site media concentrations for groundwater from landfill monitoring wells; ingestion exposures for all COCs and inhalation exposures for VOCs only.

µg/L - micrograms per liter
NA - not applicable
ND - no data documented in the BRA Report
VOCs - volatile organic compounds
PAHs - polynuclear aromatic hydrocarbons

Table 5
Cancer Toxicity Data - Oral/Dermal
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Chemical of Concern	Oral Cancer Slope Factor	Dermal Cancer Slope Factor [3]	Units	Weight of Evidence/ Cancer Guideline Description [4]	Source	Date (MM/DD/YY)
MAY 1990 BRA[1]						
PAHs						
Benzo(a)anthracene [5]	11.5	11.5	kg-day/mg	B2	SPHEM	10/01/86
Benzo(a)pyrene	11.5	11.5	kg-day/mg	B2	SPHEM	10/01/86
Benzo(b)fluoranthene [5]	11.5	11.5	kg-day/mg	B2	SPHEM	10/01/86
Benzo(g,h,i)perylene [5]	11.5	11.5	kg-day/mg	B2	SPHEM	10/01/86
Benzo(k)fluoranthene [5]	11.5	11.5	kg-day/mg	B2	SPHEM	10/01/86
Chrysene [5]	11.5	11.5	kg-day/mg	C	SPHEM	10/01/86
Dibenz(a,h)anthracene [5]	11.5	11.5	kg-day/mg	B2	SPHEM	10/01/86
Indeno(1,2,3)pyrene [5]	11.5	11.5	kg-day/mg	B2	SPHEM	10/01/86
Metals						
Arsenic	1.75	NA	kg-day/mg	A	HEAST	04/01/89
Pesticides						
Dieldrin	16	16	kg-day/mg	B2	IRIS	09/07/88
APRIL 1993 BRA[2]						
VOCs						
Benzene	0.029	NA	1/(mg/kg/d)	A	IRIS	02/92
Carbon tetrachloride	0.13	NA	1/(mg/kg/d)	B2	IRIS	02/92
Chloroform	0.0061	NA	1/(mg/kg/d)	B2	IRIS	02/92
Dichloropropene, trans-1,3-	0.18	NA	1/(mg/kg/d)	B2	HEAST	02/92
Tetrachloroethene	0.052	NA	1/(mg/kg/d)	B2	HEAST	02/92
Trichloroethane, 1,1,1-	ND	NA	ND	ND	ND	ND
Trichlorethene	0.011	NA	1/(mg/kg/d)	B2	IRIS	02/92
Vinyl chloride	1.9	NA	1/(mg/kg/d)	A	HEAST	02/92

Notes:

NA - Not applicable (only carcinogenic COCs in sediment were identified for the dermal exposure pathway).

ND - No data documented in BRA Report.

[1] - Data from Risk Assessment, Zone 1 Remedial Investigation Report, Robins Air Force Base, Warner Robins, Georgia (CH2M Hill, May 1990).

Sources:

IRIS - Integrated Risk Information System (EPA, 1988).

HEAST - Health Effects Assessment Summary Tables-Quarterly Summary (EPA, 1989).

SPHEM - Superfund Public Health Evaluation Manual (EPA, 1986).

[2] - Data from Draft Final Remedial Investigation Report for Zone 1, Operable Unit 3: Robins Air Force Base, Warner Robins, Georgia (CH2M Hill, April 1993).

Sources:

IRIS - Integrated Risk Information System (EPA, February 1992a).

HEAST - Health Effects Assessment Summary Tables-Quarterly Summary (EPA, February 1992b).

[3] - SFs were not available for the dermal route of exposure; therefore, oral SFs were also used to represent dermal SFs.

[4] - EPA Group:

A - Human carcinogen.

B1 - Probable human carcinogen - indicates that limited human data are available.

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans.

C - Possible human carcinogen.

[5] - Surrogate values based on benzo(a)pyrene.

Table 6a
Cancer Toxicity Data - Inhalation (from BRA Reports)
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Chemical of Concern	Unit Risk	Units	Inhalation Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guideline Description [3]	Source	Date (MM/DD/YY)
MAY 1990 BRA [1]							
VOCs							
Chloroform	ND	ND	0.081	kg-day/mg	B2	IRIS	06/30/88
Metals							
Arsenic	ND	ND	50	kg-day/mg	A	IRIS	12/01/88
Cadmium	ND	ND	6.1	kg-day/mg	B1	IRIS	03/01/88
Chromium [4]	ND	ND	41	kg-day/mg	A	IRIS	03/01/88
APRIL 1993 BRA [2]							
VOCs							
Benzene	ND	ND	ND	ND	ND	ND	ND
Carbon tetrachloride	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND
Dichloropropene, trans-1,3-	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	ND	ND	ND	ND	ND	ND	ND
Trichloroethane, 1,1,1-	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND	ND
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND

Notes:

ND - No data documented in BRA Report.

[1] - Data from Risk Assessment, Zone 1 Remedial Investigation Report, Robins Air Force Base, Warner Robins, Georgia (CH2M Hill, May 1990).

Sources:

IRIS - Integrated Risk Information System (EPA, 1988).

[2] - Data from Draft Final Remedial Investigation Report for Zone 1, Operable Unit 3: Robins Air Force Base, Warner Robins, Georgia (CH2M Hill, April 1993).

[3] - EPA Group:

A - Human carcinogen.

B1 - Probable human carcinogen - indicates that limited human data are available.

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans.

[4] - Toxicity data for total chromium was based on surrogate values for hexavalent chromium.

Table 6b
Additional Cancer Toxicity Data - Inhalation [1]
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Chemical of Concern	Unit Risk	Units	Inhalation Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guideline Description [4]	Source	Date [5] (MM/DD/YY)
MAY 1990 BRA [2]							
VOCs							
Chloroform	2.3E-05	(µg/m3)-1	8.1E-02	kg-day/mg	B2	IRIS	09/12/00
Metals							
Arsenic	4.3E-03	(µg/m3)-1	1.5E+01	kg-day/mg	A	IRIS	09/12/00
Cadmium	1.8E-03	(µg/m3)-1	6.3E+00	kg-day/mg	B1	IRIS	09/12/00
Chromium [6]	1.2E-02	(µg/m3)-1	4.2E+01	kg-day/mg	A	IRIS	09/12/00
APRIL 1993 BRA [3]							
VOCs							
Benzene	7.8E-06	(µg/m3)-1	2.7E-02	kg-day/mg	A	IRIS	09/12/00
Carbon tetrachloride	1.5E-05	(µg/m3)-1	5.3E-02	kg-day/mg	B2	IRIS	09/12/00
Chloroform	2.3E-05	(µg/m3)-1	8.1E-02	kg-day/mg	B2	IRIS	09/12/00
Dichloropropene, trans-1,3- [7]	4.0E-06	(µg/m3)-1	1.4E-02	kg-day/mg	B2	IRIS	09/12/00
Tetrachloroethene	5.8E-07	(µg/m3)-1	2.0E-03	kg-day/mg	C-B2	NCEA	4/13/2000
Trichloroethane, 1,1,1-	NA	NA	NA	NA	D	IRIS	09/12/00
Trichloroethene	1.7E-06	(µg/m3)-1	6.0E-03	kg-day/mg	C-B2	NCEA	4/13/2000
Vinyl Chloride	4.4E-06	(µg/m3)-1	1.5E-02	kg-day/mg	A	IRIS	09/12/00

Notes:

[1] - Toxicity data presented in this table was not obtained from the BRA Reports;
however, this information is provided in order to present all current available toxicological data for site-related COCs.

[2] - COCs from Risk Assessment, Zone 1 Remedial Investigation Report, Robins Air Force Base, Warner Robins, Georgia (CH2M Hill, May 1990).

[3] - COCs from Draft Final Remedial Investigation Report for Zone 1, Operable Unit 3: Robins Air Force Base, Warner Robins, Georgia (CH2M Hill, April 1993).

[4] - EPA Group:

A - Human carcinogen.

B1 - Probable human carcinogen - indicates that limited human data are available.

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

[5] - For IRIS values, the date IRIS was searched.
For NCEA values, the date of EPA Region III Risk-Based Concentration Table.

[6] - Toxicity data for total chromium was based on surrogate values for hexavalent chromium.

[7] - Toxicity data for trans-1,3-dichloropropene was based on surrogate values for 1,3-dichloropropene.

Table 7a
Non-Cancer Toxicity Data - Oral/Dermal (from BRA Reports)
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Chemical of Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Dermal RfD	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (MM/DD/YY)
MAY 1990 BRA[1]									
Metals									
Arsenic	ND	ND	ND	NA	ND	ND	ND	ND	ND
Cadmium	ND	0.0005	mg/kg/day	NA	ND	ND	ND	HEAST	04/01/89
Chromium[3]	ND	0.005	mg/kg/day	NA	ND	ND	ND	IRIS	03/01/88
APRIL 1993 BRA[2]									
VOCs									
Bromomethane	ND	0.0014	mg/kg/day	NA	ND	ND	ND	IRIS	1992
Butanone, 2-	ND	0.05	mg/kg/day	NA	ND	ND	ND	HEAST	1992
Carbon tetrachloride	ND	0.0007	mg/kg/day	NA	ND	ND	ND	IRIS	1992
Chlorobenzene	ND	0.02	mg/kg/day	NA	ND	ND	ND	IRIS	1992
Dichloroethene, 1,2-	ND	0.01	mg/kg/day	NA	ND	ND	ND	HEAST	1992
Tetrachloroethene	ND	0.01	mg/kg/day	NA	ND	ND	ND	IRIS	1992
Trichloroethene	ND	0.006	mg/kg/day	NA	ND	ND	ND	EPA-ECAO	ND
PAHs									
Dimethylphenol, 2,4-	ND	0.02	mg/kg/day	NA	ND	ND	ND	IRIS	1992
Dinitrophenol, 2,4-	ND	0.002	mg/kg/day	NA	ND	ND	ND	IRIS	1992
Methylphenol, 2	ND	0.05	mg/kg/day	NA	ND	ND	ND	IRIS	1992
Methylphenol, 4	ND	0.05	mg/kg/day	NA	ND	ND	ND	HEAST	1992
Metals									
Aluminum	ND	2.9	mg/kg/day	NA	ND	ND	ND	ND	ND
Arsenic	ND	0.0003	mg/kg/day	NA	ND	ND	ND	IRIS	02/92
Cadmium	ND	0.0005	mg/kg/day	NA	ND	ND	ND	IRIS	02/92
Copper	ND	0.0371	mg/kg/day	NA	ND	ND	ND	HEAST	02/92
Manganese	ND	0.1	mg/kg/day	NA	ND	ND	ND	IRIS	02/92
Mercury	ND	0.0003	mg/kg/day	NA	ND	ND	ND	HEAST	02/92
Nickel	ND	0.02	mg/kg/day	NA	ND	ND	ND	IRIS	02/92
Thallium	ND	ND	mg/kg/day	NA	ND	ND	ND	ND	02/92
Vanadium	ND	0.007	mg/kg/day	NA	ND	ND	ND	HEAST	02/92
Zinc	ND	0.2	mg/kg/day	NA	ND	ND	ND	HEAST	02/92

Notes:

NA - Not applicable (noncarcinogenic COCs were not identified for the dermal exposure pathway).

ND - No data documented in BRA Report.

[1] - Data from Risk Assessment, Zone 1 Remedial Investigation Report, Robins Air Force Base, Warner Robins, Georgia (CH2M Hill, May 1990).
Sources:
IRIS - Integrated Risk Information System (EPA, 1988).
HEAST - Health Effects Assessment Summary Tables-Quarterly Summary (EPA, 1989).

[2] - Data from Draft Final Remedial Investigation Report for Zone 1, Operable Unit 3: Robins Air Force Base, Warner Robins, Georgia (CH2M Hill, April 1993).
Sources:
IRIS - Integrated Risk Information System (EPA, February 1992a).
HEAST - Health Effects Assessment Summary Tables-Quarterly Summary (EPA, February 1992b)
EPA-ECAO - Environmental Criteria Assessment Office

[3] - Toxicity data for total chromium was based on surrogate values for hexavalent chromium.

Table 7b
Additional Non-Cancer Toxicity Data - Oral/Dermal [1]
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Chemical of Concern	Chronic/ Subchronic	Oral RfD Value [4]	Oral RfD Units	Dermal RfD	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors [5]	Sources of RfD: Target Organ	Dates of RfD: Target Organ [6] (MM/DD/YY)
MAY 1990 BRA [2]									
Metals									
Arsenic	Chronic	3.00E-04	mg/kg/day	NA	mg/kg-day	skin	3	IRIS	08/24/00
Cadmium	Chronic	5.00E-04	mg/kg/day	NA	mg/kg-day	kidney	10	IRIS	08/24/00
Chromium[3]	Chronic	3.00E-03	mg/kg/day	NA	mg/kg-day	none	900	IRIS	08/24/00
APRIL 1993 BRA [3]									
VOCs									
Bromomethane	Chronic	1.40E-03	mg/kg/day	NA	mg/kg-day	digestive system	1000	IRIS	08/24/00
Butanone, 2-	Chronic	6.00E-01	mg/kg/day	NA	mg/kg-day	body weight	3000	IRIS	08/24/00
Carbon tetrachloride	Chronic	7.00E-04	mg/kg/day	NA	mg/kg-day	liver	1000	IRIS	08/24/00
Chlorobenzene	Chronic	2.00E-02	mg/kg/day	NA	mg/kg-day	liver	1000	IRIS	08/24/00
Dichloroethene, 1,2-	Chronic	9.00E-03	mg/kg/day	NA	mg/kg-day	liver	ND	HEAST	07/97
Tetrachloroethene	Chronic	1.00E-02	mg/kg/day	NA	mg/kg-day	liver	1000	IRIS	08/24/00
Trichloroethene	Chronic	6.00E-03	mg/kg/day	NA	mg/kg-day	ND	ND	NCEA	4/13/2000
PAHs									
Dimethylphenol, 2,4-	Chronic	2.00E-02	mg/kg/day	NA	mg/kg-day	CNS/Blood	3000	IRIS	08/24/00
Dinitrophenol, 2,4-	Chronic	2.00E-03	mg/kg/day	NA	mg/kg-day	eye	1000	IRIS	08/24/00
Methylphenol, 2	Chronic	5.00E-02	mg/kg/day	NA	mg/kg-day	CNS/Body Weight	1000	IRIS	08/24/00
Methylphenol, 4	Chronic	5.00E-03	mg/kg/day	NA	mg/kg-day	CNS	ND	HEAST	11/93
Metals									
Aluminum	Chronic	1.00E+00	mg/kg/day	NA	mg/kg-day	CNS	100	NCEA	4/13/2000
Arsenic	Chronic	3.00E-04	mg/kg/day	NA	mg/kg-day	skin	3	IRIS	08/24/00
Cadmium	Chronic	5.00E-04	mg/kg/day	NA	mg/kg-day	kidney	10	IRIS	08/24/00
Copper	Chronic	3.70E-02	mg/kg/day	NA	mg/kg-day	GI	ND	HEAST	07/97
Manganese	Chronic	2.38E-02	mg/kg/day	NA	mg/kg-day	CNS	3	IRIS	08/24/00
Mercury	Chronic	3.00E-04	mg/kg/day	NA	mg/kg-day	kidney	30	HEAST	07/97
Nickel	Chronic	2.00E-02	mg/kg/day	NA	mg/kg-day	body weight	300	IRIS	08/24/00
Thallium[4]	Chronic	8.00E-05	mg/kg/day	NA	mg/kg-day	blood	3000	IRIS	08/24/00
Vanadium	Chronic	7.00E-03	mg/kg/day	NA	mg/kg-day	ND	100	HEAST	07/97
Zinc	Chronic	3.00E-01	mg/kg/day	NA	mg/kg-day	blood	3	IRIS	08/24/00

Notes:

[1] - Toxicity data presented in this table was not obtained from the BRA Reports; however, this information is provided in order to present all current available toxicological data for site-related COCs.

[2] - COCs from Risk Assessment, Zone 1 Remedial Investigation Report, Robins Air Force Base, Warner Robins, Georgia (CH2M Hill, May 1990).

[3] - COCs from Draft Final Remedial Investigation Report for Zone 1, Operable Unit 3: Robins Air Force Base, Warner Robins, Georgia (CH2M Hill, April 1993).

[4] - References Doses used for the following: hexavalent chromium used for total chromium; thallium sulfate used for thallium.

[5] - Represents Uncertainty Factor x Modifying Factor.

[6] - For IRIS values, the date IRIS was searched.
For HEAST values, the date of HEAST.
For NCEA values, the date of EPA Region III Risk-Based Concentration Table.

GI - Gastrointestinal; CNS - central nervous system.

NA - Not applicable (noncarcinogenic COCs were not identified for the dermal exposure pathway).

ND - No chemical-specific available data.

Table 8
Additional Non-Cancer Toxicity Data - Inhalation [1]
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Chemical of Concern	Chronic/ Subchronic	Inhalation RfC	Units	Inhalation RfD		Primary Target Organ	Combined Uncertainty/Modifying Factors [4]	Sources of RfC:RfD: Target Organ	Dates of RfC: Target Organ [5] (MM/DD/YY)
MAY 1990 BRA [2]									
No COCs	-	-	-	-	-	-	-	-	-
APRIL 1993 BRA [3]									
VOCs									
Bromomethane	Chronic	5.00E-03	mg/m3	1.43E-03	mg/kg-day	nasal	100	IRIS	8/24/00
Butanone, 2-	Chronic	1.00E+00	mg/m3	2.86E-01	mg/kg-day	body weight	3000	IRIS	8/24/00
Carbon tetrachloride	Chronic	2.00E-03	mg/m3	5.71E-04	mg/kg-day	ND	ND	NCEA	4/13/00
Chlorobenzene	Chronic	5.95E-02	mg/m3	1.70E-02	mg/kg-day	ND	ND	NCEA	4/13/00
Dichloroethene, 1,2-	Chronic	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	Chronic	4.90E-01	mg/m3	1.40E-01	mg/kg-day	ND	ND	NCEA	4/13/00
Trichloroethene	Chronic	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

[1] - Toxicity data presented in this table was not obtained from the BRA Reports; however, this information is provided in order to present all current available toxicological data for site-related COCs.

[2] - COCs from Risk Assessment, Zone 1 Remedial Investigation Report, Robins Air Force Base, Warner Robins, Georgia (CH2M Hill, May 1990).

[3] - COCs from Draft Final Remedial Investigation Report for Zone 1, Operable Unit 3: Robins Air Force Base, Warner Robins, Georgia (CH2M Hill, April 1993).

[4] - Represents Uncertainty Factor x Modifying Factor.

[5] - For IRIS values, the date IRIS was searched.

For NCEA values, the date of EPA Region III Risk-Based Concentration Table.

- Not applicable (no noncarcinogenic COCs identified for inhalation exposure pathway in May 1993 BRA).

ND - No chemical-specific data available.

Table 9

Risk Characterization Summary - Carcinogens and Non Carcinogens [1]

Future On-Site Adult Resident - Groundwater

Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3

Robins AFB, Georgia

Scenario Timeframe:	Future
Receptor Population:	Resident (On-Site)
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Groundwater Monitoring Well	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater - Quaternary Alluvial Aquifer and Unconfined Upper Providence Unit	Groundwater	Groundwater Tap Water and Water Vapors	LF4-6	2.E-02	5.E-02	NA	7.E-02	ND	145.34	283.92	NA	429.26
			LF4-4	8.E-02	2.E-01	NA	3.E-01	ND	13.23	24.68	NA	37.91
			RI1-6W	4.E-04	8.E-04	NA	1.E-03	ND	11.13	20.99	NA	32.12
			RI1-2W	2.E-04	5.E-04	NA	7.E-04	ND	6.76	13.27	NA	20.03
			LF4-27	2.E-04	4.E-04	NA	6.E-04	ND	5.66	11.07	NA	16.73
			LF4-WP9	2.E-04	4.E-04	NA	6.E-04	ND	4.87	9.35	NA	14.22
			LF4-25	3.E-04	6.E-04	NA	9.E-04	ND	4.68	7.93	NA	12.61
			LF4-WP7	8.E-05	2.E-04	NA	3.E-04	ND	2.52	4.72	NA	7.24
			LF4-9	7.E-05	1.E-04	NA	2.E-04	ND	2.03	3.65	NA	5.68
			LF4-WP8	2.E-04	2.E-04	NA	4.E-04	ND	2.62	3.04	NA	5.66
			LF4-WP11	4.E-05	8.E-05	NA	1.E-04	ND	2.24	2.48	NA	4.72
			LF4-23	1.E-04	2.E-04	NA	3.E-04	ND	1.58	2.88	NA	4.46
			LF4-WP5	2.E-04	3.E-05	NA	2.E-04	ND	1.55	1.76	NA	3.31
			LF4-WP10	4.E-05	7.E-05	NA	1.E-04	ND	1.49	2.18	NA	3.67
			LF4-30	2.E-05	4.E-05	NA	6.E-05	ND	2.35	1.29	NA	3.64
			LF4-PR4	3.E-04	7.E-06	NA	3.E-04	ND	2.50	0.44	NA	2.94
			RI1-7W	4.E-05	6.E-05	NA	1.E-04	ND	0.93	1.59	NA	2.52
			LF4-21	9.E-04	2.E-03	NA	3.E-03	ND	1.19	1.13	NA	2.32
			LF4-12	1.E-04	3.E-05	NA	1.E-04	ND	1.32	0.93	NA	2.25
			LF4-13	6.E-05	7.E-05	NA	1.E-04	ND	1.38	0.86	NA	2.24
			LF4-PR3	3.E-04	4.E-06	NA	3.E-04	ND	1.90	0.10	NA	2.00
			LF4-17	3.E-06	6.E-06	NA	9.E-06	ND	1.32	0.07	NA	1.39
			RI1-4W	6.E-05	4.E-05	NA	1.E-04	ND	0.46	0.76	NA	1.22
			LF4-WP12	2.E-05	2.E-05	NA	4.E-05	ND	0.55	0.58	NA	1.13
			LF4-15	2.E-05	2.E-05	NA	4.E-05	ND	1.13	NA	NA	1.13
			LF4-32ES	1.E-04	2.E-06	NA	1.E-04	NA	NA	NA	NA	NA
			LF4-18	2.E-05	1.E-05	NA	3.E-05	NA	NA	NA	NA	NA
			LF4-WP3	6.E-06	1.E-05	NA	2.E-05	NA	NA	NA	NA	NA
			LF4-16	5.E-07	1.E-06	NA	2.E-06	NA	NA	NA	NA	NA
						Total Risk Across Groundwater	NC				Total Hazard Index Across Groundwater	NC
						Total Risk Across All Media and All Exposure Routes	NC				Total Hazard Index Across All Media and All Exposure Routes	NC

Table 9

Risk Characterization Summary - Carcinogens and Non Carcinogens [1]

Future On-Site Adult Resident - Groundwater

Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3

Robins AFB, Georgia

Scenario Timeframe:	Future
Receptor Population:	Resident (On-Site)
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Groundwater Monitoring Well	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater - Confined Upper Providence Unit	Groundwater	Groundwater Tap Water and Water Vapors	LF4-42	-	5.E-06	NA	5.E-06	ND	0.42	0.94	NA	1.36
			LF4-38	5.E-05	8.E-07	NA	5.E-05	NA	NA	NA	NA	NA
			LF4-11	3.E-06	5.E-06	NA	8.E-06	NA	NA	NA	NA	NA
			LF4-40	3.E-06	7.E-06	NA	1.E-05	NA	NA	NA	NA	NA
			LF4-8	3.E-06	6.E-06	NA	9.E-06	NA	NA	NA	NA	NA
			LF4-3	6.E-06	1.E-06	NA	7.E-06	NA	NA	NA	NA	NA
			RI1-5W	3.E-06	6.E-06	NA	9.E-06	NA	NA	NA	NA	NA
			LF4-5	1.E-05	NA	NA	1.E-05	NA	NA	NA	NA	NA
			LF4-32	1.E-05	2.E-05	NA	3.E-05	NA	NA	NA	NA	NA
Groundwater - Lower Providence Unit	Groundwater	Groundwater Tap Water and Water Vapors	LF4-PR1	2.E-05	NA	NA	2.E-05	ND	2.51	NA	NA	2.51
			LF4-7	NA	NA	NA	ND	ND	0.92	0.42	NA	1.34
			LF4-45	NA	NA	NA	ND	ND	1.15	0.001	NA	1.15
			LF4-PR2	3.E-05	NA	NA	3.E-05	NA	NA	NA	NA	NA
			RI1-1W	2.E-05	3.E-06	NA	2.E-05	NA	NA	NA	NA	NA
			LF4-39	7.E-06	NA	NA	7.E-06	NA	NA	NA	NA	NA
			LF4-43	4.E-05	NA	NA	4.E-05	NA	NA	NA	NA	NA
			LF4-34ES	1.E-05	NA	NA	1.E-05	NA	NA	NA	NA	NA
			LF4-35	3.E-05	NA	NA	3.E-05	NA	NA	NA	NA	NA
			LF4-33	1.E-05	2.E-05	NA	3.E-05	NA	NA	NA	NA	NA
			RI1-3W	3.E-05	5.E-07	NA	3.E-05	NA	NA	NA	NA	NA
			LF4-10	2.E-05	NA	NA	2.E-05	NA	NA	NA	NA	NA
Groundwater - Blufftown and Cusseta Aquifer	Groundwater	Groundwater Tap Water and Water Vapors	LF4-BL3	7.E-05	NA	NA	7.E-05	ND	11.81	NA	NA	11.81
			LF4-BL2	2.E-05	NA	NA	2.E-05	ND	2.04	NA	NA	2.04
			LF4-BL1	3.E-04	NA	NA	3.E-04	ND	1.41	NA	NA	1.41
			LF4-BL5	2.E-04	NA	NA	2.E-04	ND	NA	NA	NA	NA
			LF4-BL6	1.E-05	NA	NA	1.E-05	ND	NA	NA	NA	NA
			LF4-BL4	6.E-05	NA	NA	6.E-05	ND	NA	NA	NA	NA
			LF4-36ES	5.E-05	NA	NA	5.E-05	ND	NA	NA	NA	NA
						Total Risk Across Groundwater	NC				Total Hazard Index Across Groundwater	NC
						Total Risk Across All Media and All Exposure Routes	NC				Total Hazard Index Across All Media and All Exposure Routes	NC

Notes:

[1] - Data from Draft Final Remedial Investigation Report for Zone 1, Operable Unit 3: Robins Air Force Base, Warner Robins, Georgia (CH2M Hill, April 1993); all calculations of risks and hazards are based upon sample-specific information and includes all COPCs (not COCs only).

NA- Not Applicable (note: potential risks and hazards via dermal pathway were not calculated, as pathway was considered insignificant; others as noted).

NC - total risks and hazards not calculated in the BRA Report (estimates were only presented on a per-well basis).

ND - no data documented in BRA Report.

Exposure Assumptions:

Exposure (mg/kg body weight/day) = (C x IR x EF x ED) / (BW x AT); where:

C = RME concentration of chemical in groundwater well

IR (tap water) = 2 liters/day for ingestion

IR (water vapors) = 4 liters/day (equivalent mass) for inhalation of VOCs

BW = 70 kilograms for body weight

EF = 350 days/year for exposure frequency

ED = 30 years for exposure duration

AT (carcinogens) = averaging time (70 years x 365 days/year for carcinogens)

AT (noncarcinogens) = averaging time (ED years x 365 days/year for noncarcinogens)

Table 10
Summary of Final Chemicals of Concern in Groundwater [1]
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Point	Chemical of Concern [2]	Concentration Detected [3] Minimum	Maximum	Mean	Units	Frequency of Detection	Exposure Point Concentration [4]	Exposure Point Concentration Units	Statistical Measure [4]
Surficial Aquifer	VOCs								
	Benzene	6.70E-01	1.00E+02	8.19E+00	µg/L	25/33	1.00E+02	µg/L	MAX
	Chlorobenzene	1.80E+00	4.50E+02	2.85E+01	µg/L	26/33	4.50E+02	µg/L	MAX
	Dichloroethene, cis-1,2-	6.00E-01	1.30E+03	2.79E+01	µg/L	11/33	1.30E+03	µg/L	MAX
	Cis-1,2-dichloroethene								
	Tetrachloroethene	1.10E+00	5.40E+01	7.71E+00	µg/L	7/33	5.40E+01	µg/L	MAX
	Trichloroethene	2.40E+00	5.90E+02	3.76E+01	µg/L	12/33	5.90E+02	µg/L	MAX
	Metals								
	Arsenic	3.00E+00	3.94E+02	3.44E+01	µg/L	21/33	3.94E+02	µg/L	MAX
	Cadmium	3.00E-01	4.53E+01	3.69E+00	µg/L	26/33	4.53E+01	µg/L	MAX
	Chromium	5.00E-01	5.73E+01	5.35E+00	µg/L	29/33	5.73E+01	µg/L	MAX
	Lead	1.30E+00	1.13E+02	1.21E+01	µg/L	25/33	1.13E+02	µg/L	MAX
Quaternary Alluvial Aquifer	VOCs								
	Carbon tetrachloride	5.00E-01	3.80E+01	4.36E+00	µg/L	21/36	3.80E+01	µg/L	MAX
	Chlorobenzene	7.40E-01	8.50E+02	2.51E+01	µg/L	7/36	8.50E+02	µg/L	MAX
	Tetrachloroethene	6.20E-01	1.50E+02	9.64E+00	µg/L	23/36	1.50E+02	µg/L	MAX
	Trichloroethene	5.30E-01	8.40E+02	2.11E+01	µg/L	32/36	8.40E+02	µg/L	MAX
	Vinyl chloride	3.10E+00	1.70E+02	2.30E+01	µg/L	3/36	1.70E+02	µg/L	MAX
Upper Providence Unit	VOCs								
	Carbon tetrachloride	5.00E-01	3.80E+01	4.36E+00	µg/L	21/36	3.80E+01	µg/L	MAX
	Tetrachloroethene	6.20E-01	1.50E+02	9.64E+00	µg/L	23/36	1.50E+02	µg/L	MAX
	Trichloroethene	5.30E-01	8.40E+02	2.11E+01	µg/L	32/36	8.40E+02	µg/L	MAX

Notes:

[1] - Information presented in this table obtained from Draft Final Feasibility Study Report for Zone 1, Operable Units 1 and 3 (Volume 1), Robins Air Force Base, Warner Robins, Georgia (Earth Tech/RUST E & I, August 1999).

[2] - Chemicals of Concern (COCs) are identified as those chemicals which exceed chemical-specific MCLs (Earth Tech/Rust E&I, 1999).

[3] - Detected concentrations are reported in the FS based upon analytical groundwater data from the Spring 1998 Basewide Sampling (Rust E & I, 1998).

[4] - Exposure point concentration is based upon the maximum detected concentration (MAX) detected in on-site monitoring wells.

µg/L - micrograms per liter
NA - not applicable
MAX - maximum detected concentration
MCLs - maximum contaminant levels
VOCs - volatile organic compounds

Table 11
Comparative Analysis of Alternatives for OU3
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Criteria	**Alternative 1** Baseline Conditions	**Alternative 2** Monitored Natural Attenuation	**Alternative 3a** No Action - Continued Operation of OU3 Interim Action	**Alternative 3b**[(1)] Optimized OU3 Interim Action with Monitored Natural Attenuation	**Alternative 4** Hot Spot Removal	**Alternative 5a** Hot Spot Removal & Continued Operation of OU3 Interim Action	**Alternative 5b** Hot Spot Removal & Optimized Operation of OU3 Interim Action	**Alternative 6** Complete Extraction of Impacted Groundwater
OVERALL PROTECTIVENESS								
Human Health Protection								
Direct Contact/Soil Ingestion	Cap and stabilization has reduced direct contact risk and soil ingestion risk to less than 1 x 10^{-5}.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Groundwater Ingestion for Current Users	There are no current users of groundwater.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Groundwater Ingestion for Potential Future Users	No reduction in risk.	COC levels in aquifer estimated to achieve MCLs by natural attenuation in greater than 50 years.	Plume migration controlled by pumping. COC levels in aquifer estimated to achieve MCLs by natural attenuation in less than 30 years.	Same as Alternative 3a except optimized system allows for greater removal of groundwater contamination.	COC levels in aquifer estimated to achieve MCLs by hot spot removal in greater than 40 years. Groundwater not likely to be useable since remediation not likely to be successful.	Same as Alternative 3a.	Same as Alternative 3a except optimized system allows for greater removal of groundwater contamination.	Same as Alternative 3a but the most protective since groundwater contamination is completely removed.
Environmental Protection	Migration of COCs by runoff and leaching is eliminated by use of cap. Allows continued contamination of the groundwater	Migration of COCs by runoff and leaching is eliminated by use of cap. Continued migration of existing contaminated groundwater is allowed.	Migration of COCs by runoff and leaching is eliminated by use of cap. Migration of contaminated groundwater is controlled by pumping.	Same as Alternative 3a except optimized system allows for greater removal of groundwater contamination.	Migration of COCs by runoff and leaching is eliminated by use of cap. Migration of contaminated groundwater is controlled by hot spot removal.	Same as Alternative 3a.	Same as Alternative 3a except optimized system allows for greater removal of groundwater contamination.	Same as Alternative 3a but the most protective since groundwater contamination is completely removed.
COMPLIANCE WITH ARARs								
Chemical-Specific ARARs	Groundwater will always exceed MCLs.	Would meet MCLs in over 50 years.	Would meet MCLs in less than 30 years.	Same as Alternative 3a.	Would meet MCLs in greater than 40 years.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.
Location-Specific ARARs	Would not meet location-specific ARARs.	Would not meet location-specific ARARs.	Would meet location-specific ARARs	Same as Alternative 3a.	Would not meet location-specific ARARs.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.

Table 11
Comparative Analysis of Alternatives for OU3
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Criteria	**Alternative 1** Baseline Conditions	**Alternative 2** Monitored Natural Attenuation	**Alternative 3a** No Action - Continued Operation of OU3 Interim Action	**Alternative 3b**[(1)] Optimized OU3 Interim Action with Monitored Natural Attenuation	**Alternative 4** Hot Spot Removal	**Alternative 5a** Hot Spot Removal & Continued Operation of OU3 Interim Action	**Alternative 5b** Hot Spot Removal & Optimized Operation of OU3 Interim Action	**Alternative 6** Complete Extraction of Impacted Groundwater
Action-Specific ARARs	Meets RCRA minimum technology requirements for caps. No other action-specific ARARs	Same as Alternative 1.	Meets RCRA minimum technology requirements for caps. Action-specific ARARs associated with Alternative 3a were managed as part of the OU3 Interim Action. No additional action-specific ARARs are required for this alternative.	Same as Alternative 3a.	Meets RCRA minimum technology requirements for caps. Action-specific ARARs include construction permits for extraction wells and control of air emissions from groundwater treatment units.	Same as Alternative 4.	Same as Alternative 4.	Same as Alternative 4 plus NPDES requirements from increased flow rate to groundwater treatment plant.
Other Criteria and Guidance	Would allow ingestion of groundwater exceeding MCLs for future users.	Would allow ingestion of groundwater exceeding MCLs for future users.	More likely to meet ARARs.	More likely to meet ARARs than Alternative 3a.	Due to potential failure of remediation system, ARARs not likely to ever be met.	More likely to meet ARARs than Alternative 3a.	More likely to meet ARARs than Alternative 3a.	Most likely to meet ARARs than all alternatives.
LONG TERM EFFECTIVENESS AND PERMANENCE								
Magnitude of Residual Risk								
Direct Contact/Soil Ingestion	Risk from OU1 source materials is contained.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Groundwater Ingestion for Current Users	There are no current users of groundwater.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Groundwater Ingestion for Potential Future Users	High risk remains for future users.	Ability for complete clean-up of groundwater by natural attenuation is not likely.	Eventual clean-up of groundwater likely but use of some groundwater from the Surficial Aquifer may be limited due to residual metals contamination.	Residual risk less than 3a due to optimized removal system .	Residual risk greater than all other alternatives except 1 and 2.	Residual risk less than 3a due to addition of hot spot removal .	Residual risk less than 3b due to addition of hot spot removal .	Best alternative for residual risk.
Adequacy and Reliability of Controls	No controls over remaining contamination. No reliability.	Low reliability for natural attenuation alone.	Reliability of existing groundwater pump and treat system is high.	Reliability of optimized groundwater pump and treat system would be high.	Hot spot removal alone is not reliable based on past experience at site.	Same as Alternative 4.	Same as Alternative 4.	High reliability for complete groundwater pump and treat system.
	Contaminants would remain on-site above health-based levels.	Contaminants would remain on-site above health-based levels.			Hot spot removal could compromise the integrity of the cap.			

Table 11
Comparative Analysis of Alternatives for OU3
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Criteria	**Alternative 1** Baseline Conditions	**Alternative 2** Monitored Natural Attenuation	**Alternative 3a** No Action - Continued Operation of OU3 Interim Action	**Alternative 3b**[(1)] Optimized OU3 Interim Action with Monitored Natural Attenuation	**Alternative 4** Hot Spot Removal	**Alternative 5a** Hot Spot Removal & Continued Operation of OU3 Interim Action	**Alternative 5b** Hot Spot Removal & Optimized Operation of OU3 Interim Action	**Alternative 6** Complete Extraction of Impacted Groundwater
REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT								
Treatment Process Used	None.	None.	Groundwater pump and treat by ozonation and carbon adsorption.	Groundwater pump and treat by ozonation and carbon adsorption.	Air sparging with soil vapor extraction.	Air sparging with soil vapor extraction. Groundwater pump and treat by ozonation and carbon adsorption.	Air sparging with soil vapor extraction. Groundwater pump and treat by ozonation and carbon adsorption.	Groundwater pump and treat by ozonation and carbon adsorption.
Amount Destroyed or Treated	None.	None.	Estimated 95% of volatiles in groundwater removed and destroyed by ozonation and carbon absorption.	Estimated 99% of volatiles in groundwater removed and destroyed by ozonation and carbon absorption.	Estimated 80% of volatiles in groundwater removed by air sparging.	Estimated 99% of volatiles in groundwater removed and destroyed by air sparging, ozonation, and carbon absorption.	Estimated 99+% of volatiles in groundwater removed and destroyed by air sparging, ozonation, and carbon absorption.	Estimated 100% of volatiles in groundwater removed and destroyed by ozonation and carbon absorption.
Reduction of Toxicity, Mobility, or Volume	None.	Some reduction of toxicity but no volume.	Reduced volume and toxicity of contaminated groundwater.	Greater reduced volume and toxicity of contaminated groundwater than alternative 3a.	Some reduction of toxicity but no volume.	Reduced volume and toxicity of contaminated groundwater.	Greater reduced volume and toxicity of contaminated groundwater than all alternatives except alternative 6.	Complete reduction of volume and toxicity.
Irreversible Treatment	None.	None.	Yes, unless residual contamination leaches to groundwater after treatment.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.
Type and Quantity of Residuals Remaining After Treatment	Groundwater contamination remains.	Groundwater contamination remains.	Small quantity of immobile metals may remain.	Same as Alternative 3a	Groundwater contamination likely remains.	Same as Alternative 3a	Same as Alternative 3a	Same as Alternative 3a
SHORT-TERM EFFECTIVENESS								
Community Protection	Risk to community through recreational users of downgradient wetlands remains due to no action.	Risk to community through recreational users of downgradient wetlands is likely with this alternative.	Risk to community minimal	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.	Same as Alternative 3a.
Worker Protection	No risk to workers.	Negligible risk occurs during sampling for natural attenuation.	Negligible risk to workers during inspections of groundwater extraction system and during sampling.	Same as Alternative 3a.	Greater risk to workers since cap will be breeched to install air sparge wells.	Same as Alternative 4.	Same as Alternative 4.	Greater risk to workers since cap will be breeched to install additional extraction wells.

Table 11
Comparative Analysis of Alternatives for OU3
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Criteria	**Alternative 1** Baseline Conditions	**Alternative 2** Monitored Natural Attenuation	**Alternative 3a** No Action - Continued Operation of OU3 Interim Action	**Alternative 3b**[(1)] Optimized OU3 Interim Action with Monitored Natural Attenuation	**Alternative 4** Hot Spot Removal	**Alternative 5a** Hot Spot Removal & Continued Operation of OU3 Interim Action	**Alternative 5b** Hot Spot Removal & Optimized Operation of OU3 Interim Action	**Alternative 6** Complete Extraction of Impacted Groundwater
Environmental Impacts	Continued impacts from existing conditions.	Some migration of contaminant plume as part of attenuation process.	Some migration of contaminant plume to wetlands area.	Same as Alternative 3a.	Considerable migration of contaminant plume to wetlands area. Air impacts from vapor extraction.	Some migration of contaminant plume to wetlands area. Air impacts from vapor extraction.	Same as Alternative 5a.	Lowest impact to environment of all alternatives.
Time Until Action Is Complete	Not applicable.	Immediate implementation.	Immediate implementation.	Design and implementation of optimized interim action would take 6 months,	Design and installation of AS/SVE system would take 18 months.	Same as Alternative 4.	Same as Alternative 4.	Design and implementation of scaled-up groundwater treatment plant would be 30 months.
IMPLEMENTABILITY								
Ability to Construct and Operate	No construction or operation.	No construction or operation.	Already constructed.	Already constructed.	Difficult to construct and time consuming to operate.	Same as Alternative 4.	Same as Alternative 4.	Same as Alternative 4.
Ease of Doing More Action If Needed	May require ROD amendment if future problems arise.	May require ROD amendment if future problems arise.	Easy to increase flow rate. Difficult if additional extraction wells are needed.	Same as Alternative 3a.	Difficult to add additional sparge/SVE points.	Same as Alternative 4.	Same as Alternative 4.	Difficult to add additional extraction wells.
Ability to Monitor Effectiveness	No monitoring.	Monitoring and maintenance inspections included with alternative.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Ability to Obtain Approvals and Coordinate With Other Agencies.	None required.	Same as Alternative 1.	Same as Alternative 1.	Minor approvals required.	Significant approvals required due to intrusion into cap and air permitting issues.	Same as Alternative 4.	Same as Alternative 4.	More extensive approvals required due to intrusion into cap. Revision of NPDES permit.
Availability of Equipment, Specialists, and Materials	None required.	None required.	None required.	Personnel readily available to provide groundwater modeling to determine optimized system parameters.	Extensive equipment and specialists required due to intrusion into cap may not be readily available.	Same as Alternative 4.	Same as Alternative 4.	Same as Alternative 4.
Availability of Technologies	None required.	None required.	None required.	Specialized for this site.	Readily available.	Same as Alternative 4	Same as Alternative 4	Specialized for this site.

Table 11
Comparative Analysis of Alternatives for OU3
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Criteria	**Alternative 1** Baseline Conditions	**Alternative 2** Monitored Natural Attenuation	**Alternative 3a** No Action - Continued Operation of OU3 Interim Action	**Alternative 3b**[1] Optimized OU3 Interim Action with Monitored Natural Attenuation	**Alternative 4** Hot Spot Removal	**Alternative 5a** Hot Spot Removal & Continued Operation of OU3 Interim Action	**Alternative 5b** Hot Spot Removal & Optimized Operation of OU3 Interim Action	**Alternative 6** Complete Extraction of Impacted Groundwater
COST								
Capital Cost	$0	$0	$1,000,000	$500,000	$1,800,000	$2,800,000	$2,800,000	$10,000,000
Annual O&M Cost	$0	$65,000	$1,000,000	$932,000	$124,000	$1,200,000	$1,200,000	$3,000,000
Present Worth Cost	$76,000	$882,000	$11,587,000	$12,059,000[2]	$3,562,000	$17,914,000	$17,914,000	$47,450,000
STATE ACCEPTANCE	Not acceptable. Not protective of human health and environment.	Not acceptable. Not a permanent solution.	Acceptable.	Acceptable.	Not acceptable due to intrusion into cap.	Same as Alternative 4.	Same as Alternative 4.	Not acceptable
COMMUNITY ACCEPTANCE	Not acceptable.	Not acceptable.	Acceptable.	Acceptable.	Not acceptable.	Not acceptable.	Not acceptable.	Not acceptable

Notes:

(1) - These costs are based upon the 30 year scenario. Actual time frames and cost are dependent upon the evaluation of the groundwater extraction system effectiveness.

(2) - US EPA guidance specifies that costs are to be presented in terms of present worth. However, it should be noted that a different economic analysis including escalated costs was presented in the FS (Earth Tech/RUST E&I, 1999a). Therefore, the cost estimates presented here and in the FS are not comparable.

Table 12
Cost Estimate Summary for the OU3 Selected Final Remedy
(10 year and 30 year Scenarios)
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Description	Quantity	Unit	Unit Cost	Cost
Capital Costs (for 10 year and 30 year periods (P))				
1. Remedial Design/Groundwater Optimization Study	1	LS	$400,000	$400,000
			Subtotal	$400,000
Contingency Allowances (15%)				$60,000
Project Management and Support (10%)				$40,000
		Total Capital Costs:		**$500,000**
Annual Operation & Maintenance (P = 10 years)				
Groundwater Monitoring	10	per year	$239,000	$2,390,000
Operation of Groundwater Treatment Plant [1]	10	per year	$433,000	$4,330,000
CERCLA Five Year Review	2	review periods	$90,000	$180,000
			Subtotal	$6,900,000
Contingency Allowances (25%)				$1,725,000
Project Management Support (15%)				$690,000
	Total O&M Costs:			$9,315,000
Equivalent Uniform Annual O&M Cost (P = 10 yrs)			**$931,500**	
Net Present Worth of Capital Costs and O&M Costs (I = 7%, P = 10 yrs)				**$7,041,925**
Annual Operation & Maintenance (P = 30 years)				
Groundwater Monitoring	30	per year	$239,000	$7,170,000
Operation of Groundwater Treatment Plant [(1)]	30	per year	$433,000	$12,990,000
CERCLA Five Year Review	6	review periods	$90,000	$540,000
			Subtotal	$20,700,000
Contingency Allowances (25%)				$5,175,000
Project Management Support (15%)				$2,070,000
	Total O&M Costs:			$27,945,000
Equivalent Uniform Annual O&M Cost (P = 30 yrs)			**$931,500**	
Net Present Worth of Capital Costs and O&M Costs (I = 7%, P = 30 yrs)				**$12,058,984**

Notes:
LS = Lump Sum
[(1)] = Annual costs associated with treatment of up to 50 gpm of groundwater through the groundwater treatment plant.

1. These costs are based upon 10 year and 30 year scenarios; actual time frames and cost are dependent up the evaluation of the groundwater extraction system effectiveness.

2. US EPA guidance specifies that costs are to be presented in terms of present worth. However, it should be noted that a different economic analysis including escalated costs was presented in the FS (Earth Tech/RUST E&I, 1999a). Therefore, the cost estimates presented here and in the FS are not comparable.

Table 12
Cost Estimate Summary for the OU3 Selected Final Remedy
(10 year and 30 year Scenarios)
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Summary of Present Worth Analysis

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (7%)	Present Worth (P = 10 years)	Present Worth (P = 30 years)
0	$500,000		$500,000	1.000	$500,000	$500,000
1		$931,500	$931,500	0.935	$870,953	$870,953
2		$931,500	$931,500	0.873	$813,200	$813,200
3		$931,500	$931,500	0.816	$760,104	$760,104
4		$931,500	$931,500	0.763	$710,735	$710,735
5		$931,500	$931,500	0.713	$664,160	$664,160
6		$931,500	$931,500	0.666	$620,379	$620,379
7		$931,500	$931,500	0.623	$580,325	$580,325
8		$931,500	$931,500	0.582	$542,133	$542,133
9		$931,500	$931,500	0.544	$506,736	$506,736
10		$931,500	$931,500	0.508	$473,202	$473,202
11		$931,500	$931,500	0.475	-	$442,463
12		$931,500	$931,500	0.444	-	$413,586
13		$931,500	$931,500	0.415	-	$386,573
14		$931,500	$931,500	0.388	-	$361,422
15		$931,500	$931,500	0.362	-	$337,203
16		$931,500	$931,500	0.339	-	$315,779
17		$931,500	$931,500	0.317	-	$295,286
18		$931,500	$931,500	0.296	-	$275,724
19		$931,500	$931,500	0.277	-	$258,026
20		$931,500	$931,500	0.258	-	$240,327
21		$931,500	$931,500	0.242	-	$225,423
22		$931,500	$931,500	0.226	-	$210,519
23		$931,500	$931,500	0.211	-	$196,547
24		$931,500	$931,500	0.197	-	$183,506
25		$931,500	$931,500	0.184	-	$171,396
26		$931,500	$931,500	0.172	-	$160,218
27		$931,500	$931,500	0.161	-	$149,972
28		$931,500	$931,500	0.150	-	$139,725
29		$931,500	$931,500	0.141	-	$131,342
30		$931,500	$931,500	0.131	-	$122,027
	$500,000	$27,945,000	$28,445,000		$7,041,925	$12,058,984
	TOTAL PRESENT WORTH COSTS				**$7,041,925**	**$12,058,984**

Notes: Capital cost estimates are not discounted because the construction work will be performed in the first year. O&M costs are reported as present worth estimates given a 7% discount rate for both a 10 year and a 30 year duration. Costs estimates are within +50 to -30% accuracy expectation. Project management and support should account for the cost of remedial design and the administrative/project management costs for the remedial design/remedial action and O&M.

Table 13
Decision Matrix for Comparison of Alternatives
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Criterion	Remedial Alternatives							
	Alternative I	**Alternative 2**	**Alternative 3a**	**Alternative 3b**	**Alternative 4**	**Alternative 5a**	**Alternative 5b**	**Alternative 6**
Overall Protectiveness								
Human Health	✗	✔	✔	✔	✔	✔	✔	✔
Environment	✗	*	✔	✔	✔	✔	✔	✔
Compliance with ARARs								
Chemical	✗	*	✔	✔	✔	✔	✔	✔
Location	✗	*	✔	✔	✔	✔	✔	✔
Action	✗	✔	✔	✔	*	*	*	*
Long-Term Effectiveness and Permanence								
Magnitude of residual risks	✗	✔	✔	✔	*	✔	✔	✔
Adequacy of controls	✗	✔	✔	✔	✔	✔	✔	✔
Reduction in Toxicity, Mobility, or Volume Through Treatment								
Reduction	✗	*	✔	✔	*	*	*	✔
Short-Term Effectiveness								
Risk to community or workers	*	✔	✔	✔	*	*	*	*
Time frame to achieve MCLs	✗	*	✔	✔	✔	✔	✔	✔
Implementability								
Ease of Implementation	*	✔	✔	✔	*	*	*	*
Costs								
Total escalated costs (1)	$200,000	$4,200,000	$67,000,000	$46,000,000	$8,900,000	$88,000,000	$63,000,000	$104,000,000

Notes:

(1) Economic Analysis included escalated costs as presented in the Feasibility Study (Earth Tech/RUST E&I, 1999a).

✔ Meets Criteria

✗ Does Not Meet Criteria

* Has Concerns, May or May Not Meet Criteria

Table 14
Description of ARARs for Selected Remedy
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Authority	Medium	Requirement	Status	Synopsis of Requirement	Action to be Taken to Attain Requirement
State Regulatory Requirement	Soil	State Hazardous Waste Management Rules	Applicable	These rules set forth the State's definitions and criteria for establishing whether waste materials are hazardous and subject to associated hazardous waste regulations. These rules identify requirements for hazardous waste generators and land disposal restrictions.	The Selected Remedy will comply with these requirements through containment via capping of the landfill.
Federal Regulatory Requirement	Groundwater	Federal Safe Drinking Water Maximum Contaminant Levels (MCLs)	Relevant and Appropriate	MCLs have been regulated for a number of common organic and inorganic contaminants. These levels regulate the concentrations of contaminants in public drinking water supplies and are considered relevant and appropriate for groundwater aquifers potentially used for drinking water.	The Selected Remedy will comply with these regulations through source control measures and monitored natural attenuation. The exception to this are residual metals remaining in the Surficial Aquifer of the waste mass which would be regulated under the RCRA land disposal regulations, 40 CFR 264 and 40 CFR 268 (see below).
Federal Regulatory Requirement	Groundwater	RCRA disposal requirements (40 CFR 264) and land disposal restrictions (40 CFR 268) for groundwater-treatment residuals	Relevant and Appropriate	RCRA disposal requirements have been developed to protect human health and the environment.	The Selected Remedy will comply with these regulations through source control measures.
Federal Regulatory Requirement	Surface Water	Clean Water Act (40 CFR 122)	Relevant and Appropriate	Standards have been developed to protect human health and the environment from direct discharge of treatment effluent.	The Selected Remedy will comply with these regulations through proper treatment of contaminated groundwater extracted from the NPL site.
Federal Regulatory Requirement	Wetland	Protection of Wetlands, Executive Order 11990 (40 CFR Part 6)	TBC	These requirements regulate actions that occur in wetlands and may be applicable to actions that may adversely affect wetlands.	The Selected Remedy will indirectly help to protect the wetlands.

Note:
TBC = To Be Considered

DATE: 19 Apr, 2004 TIME: 1049

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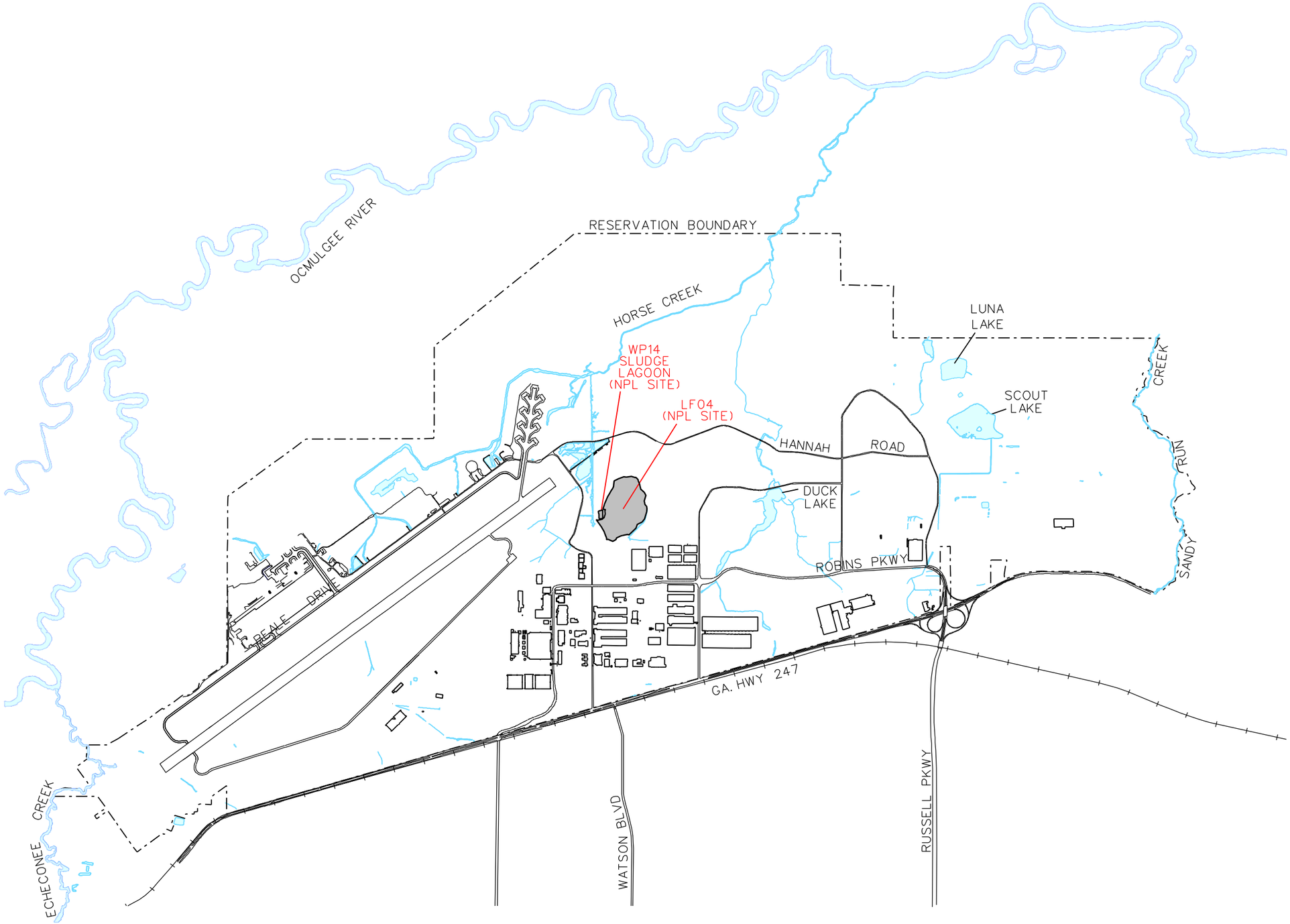

0' 3000' 6000'

SCALE

SOURCE:
BASEWIDE GROUNDWATER SAMPLING
REPORT SPRING 2003
(EARTHTECH, 2003)

WRALC

ROBINS AIR FORCE BASE, GEORGIA

FIGURE 1
SITE LOCATION MAP

RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA
MARCH 2004

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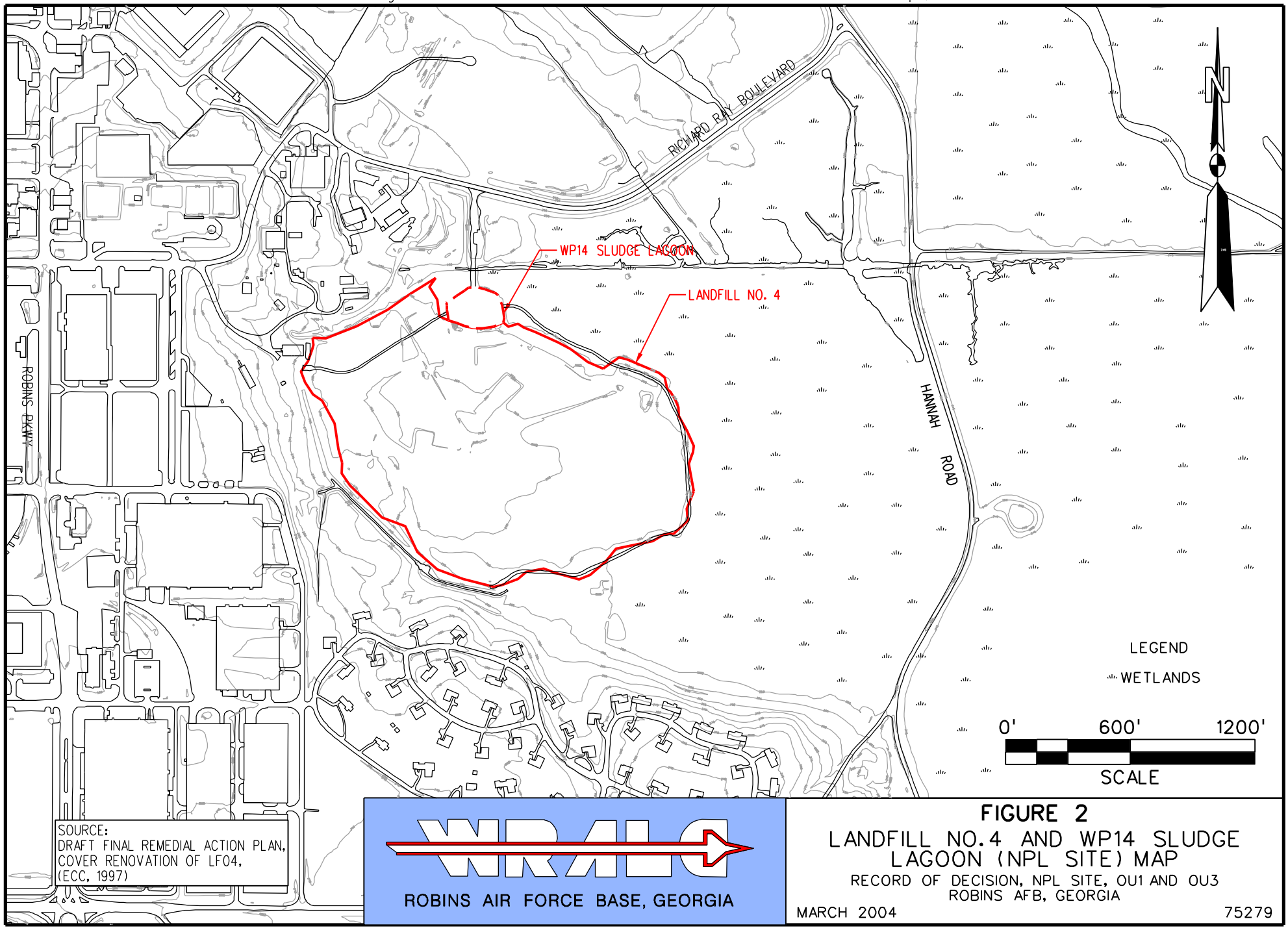

SOURCE:
DRAFT FINAL REMEDIAL ACTION PLAN,
COVER RENOVATION OF LF04,
(ECC, 1997)

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FIGURE 2
LANDFILL NO. 4 AND WP14 SLUDGE LAGOON (NPL SITE) MAP

RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

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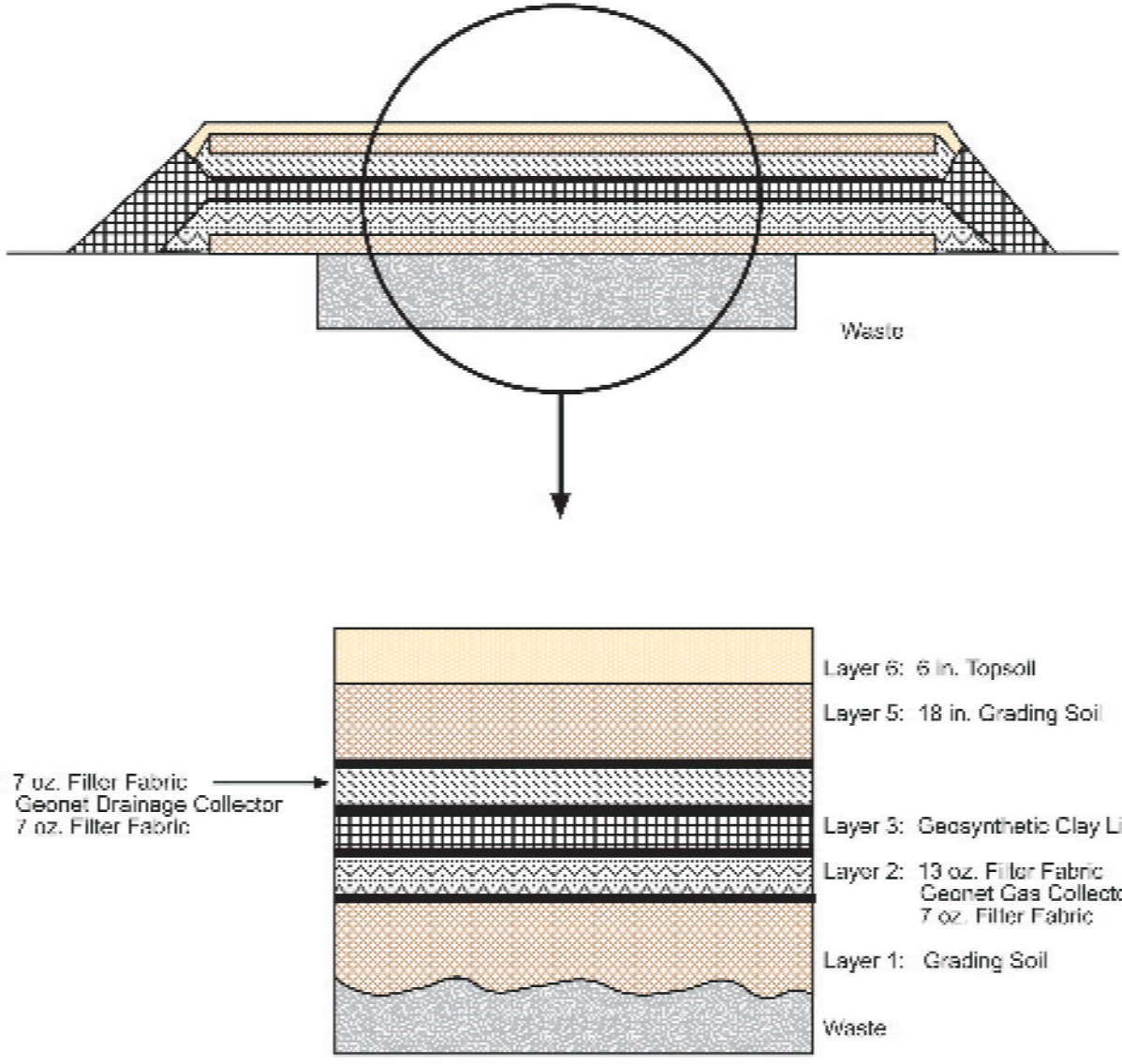

SOURCE:
DRAFT FINAL REMEDIAL ACTION PLAN,
COVER RENOVATION OF LF04,
(ECC, 1997)

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FIGURE 3

LANDFILL NO. 4 AND WP14 SLUDGE LAGOON CAPPING SYSTEM

RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

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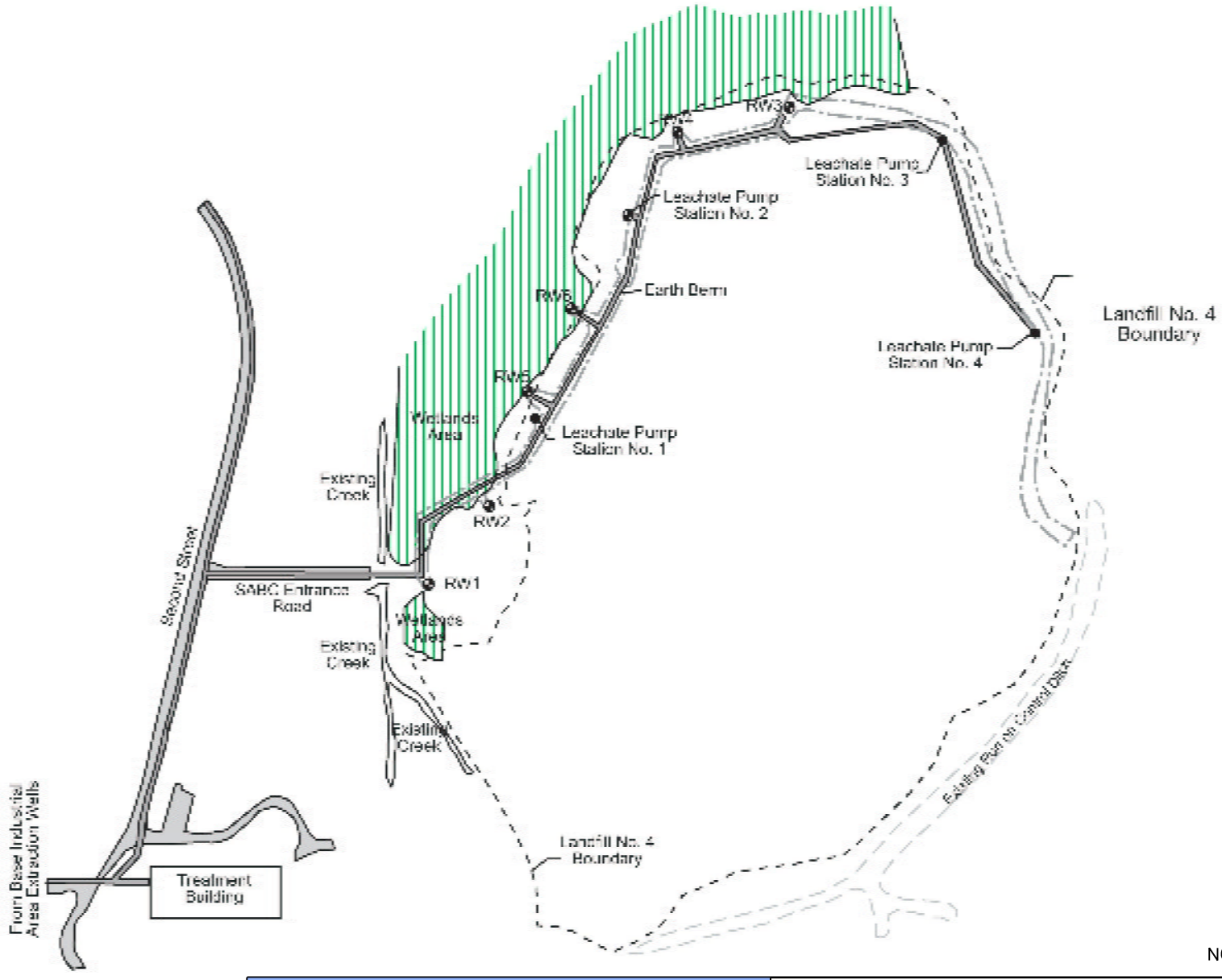
...\75279035.dgn DATE: 19 Apr, 2004 TIME: 1055



NOT TO SCALE

SOURCE:
DRAFT FINAL REMEDIAL ACTION PLAN, COVER RENOVATION OF LF04, (ECC, 1997)

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FIGURE 4

GROUNDWATER EXTRACTION SYSTEM

RECORD OF DECISION, NPL SITE, OU1 AND OU3
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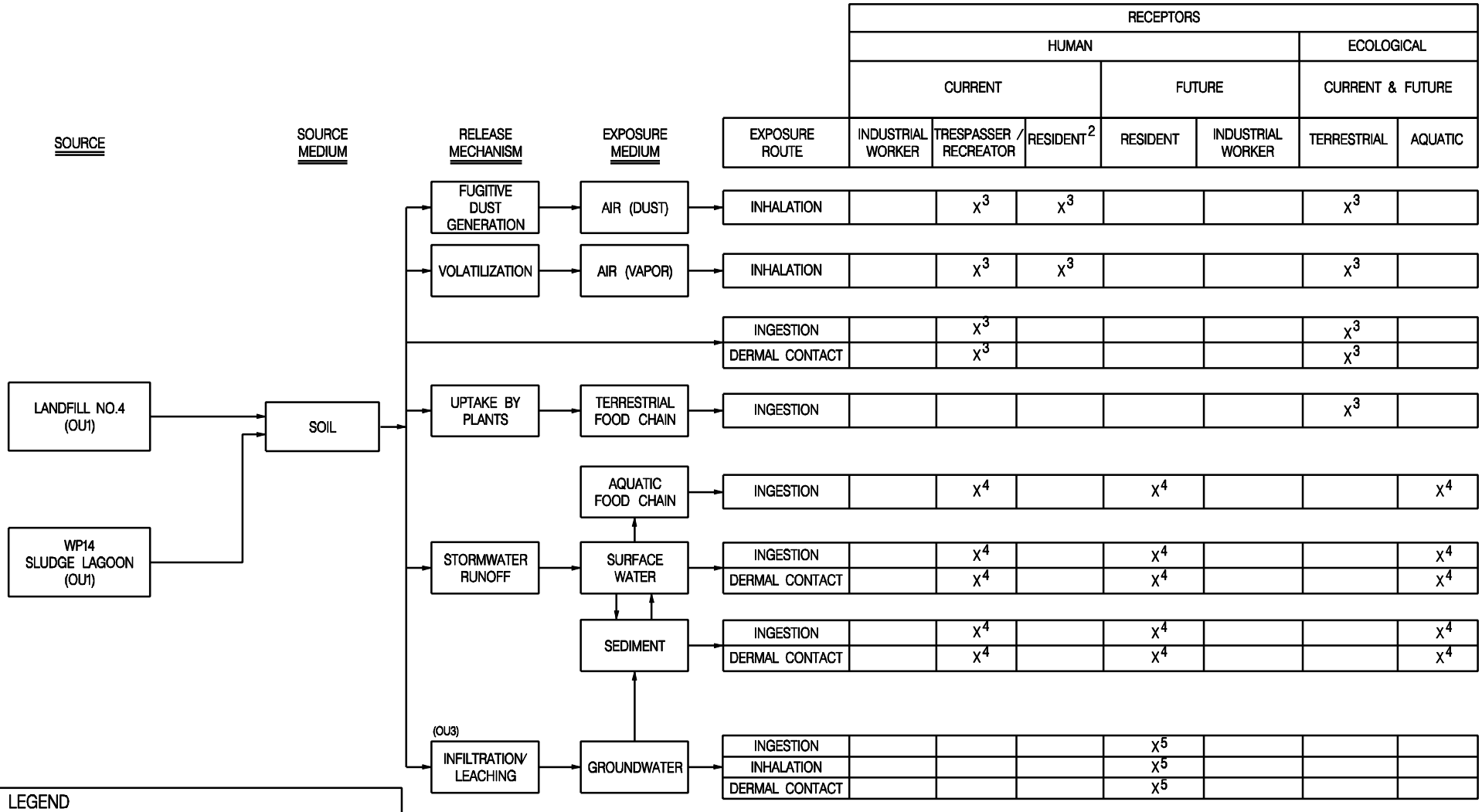

LEGEND

1- INFORMATION FOR CSM BASED UPON POTENTIAL RECEPTORS AND EXPOSURE PATHWAYS IDENTIFIED IN THE BRA ZONE 1, OU3 (CH_2M HILL, MAY 1990 & APRIL 1993).
2- CURRENT RESIDENTIAL SCENARIO (OFF-SITE) EVALUATED FOR NEARBY BASE HOUSING LOCATED SOUTH OF THE SITE.
3- ALL POTENTIAL EXPOSURES FOR OU1 ARE PRESENTLY CONSIDERED INCOMPLETE AND/OR INSIGNIFICANT DUE TO COMPLETION OF INTERIM ACTIONS.
4- OFF-SITE WETLAND RECEPTORS WERE ADDRESSED IN BRA FOR OU2 WETLANDS STUDY AREA AND ARE NOT INCLUDED IN THIS ROD.
5- POTENTIAL GROUNDWATER EXPOSURES ARE PRESENTED FOR OU3 ONLY; BASED ON HYPOTHETICAL FUTURE ON-SITE GROUNDWATER USE OF UPPER AQUIFERS.
X- INDICATES POTENTIALLY COMPLETE EXPOSURE PATHWAY TO RECEPTOR. EMPTY BOXES REPRESENT INCOMPLETE PATHWAYS.

SOURCE:
DRAFT FINAL REMEDIAL ACTION PLAN, COVER RENOVATION OF LF04, (ECC, 1997)- WITH EDITS

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FIGURE 5
CONCEPTUAL SITE MODEL

RECORD OF DECISION, NPL SITE, OU1 AND OU3
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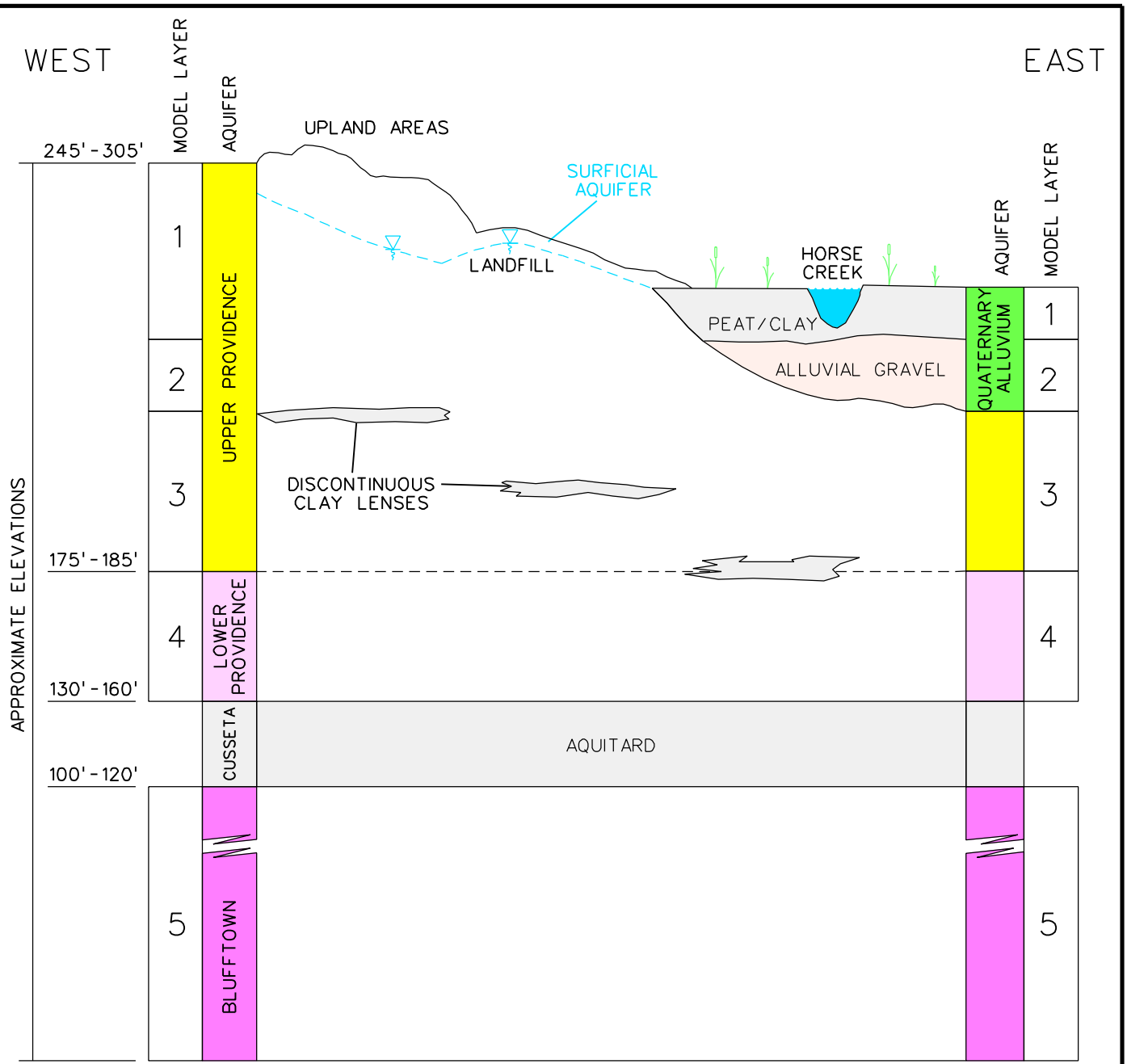

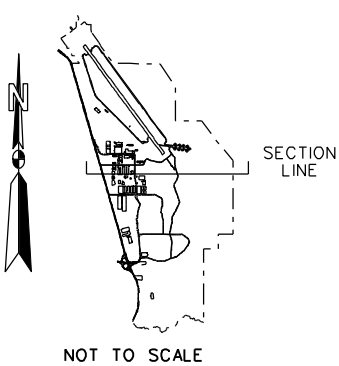

NOT TO SCALE

SOURCE:
BASEWIDE GROUNDWATER SAMPLING
REPORT SPRING 1998 (RUST E & I, 1998)

NOT TO SCALE

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DATE: 19 Apr, 2004 TIME: 1102

ROBINS AIR FORCE BASE, GEORGIA

FIGURE 6
REGIONAL GEOLOGIC CROSS SECTION

RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

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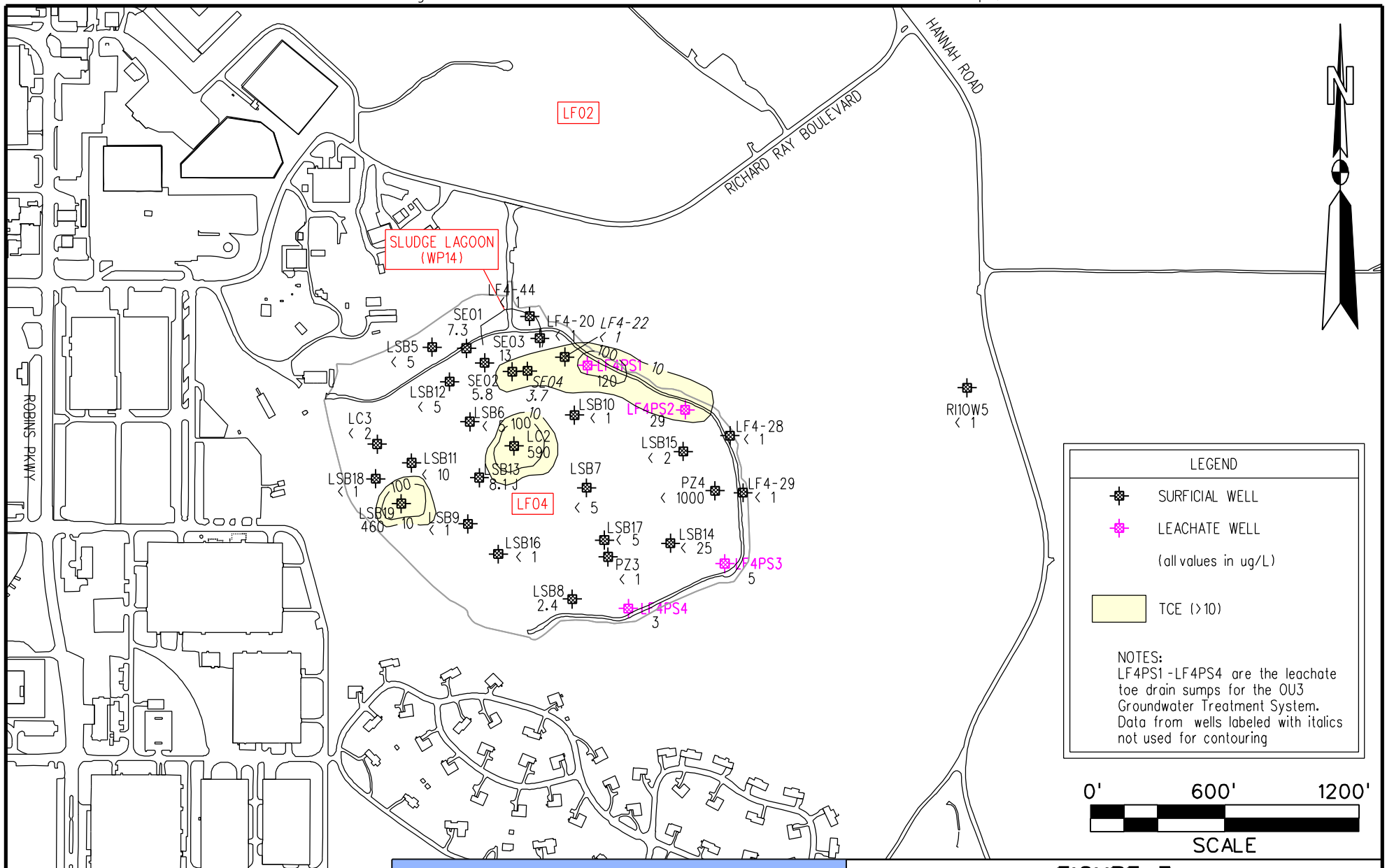
...\75279039.dgn DATE: 19 Apr, 2004 TIME: 1103



SOURCE:
BASEWIDE GROUNDWATER SAMPLING
REPORT SPRING 1998 (RUST E & I, 1998)

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FIGURE 7
1998 TCE CONCENTRATIONS SURFICIAL AQUIFER
RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

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...\75279047.dgn DATE: 19 Apr, 2004 TIME: 1106

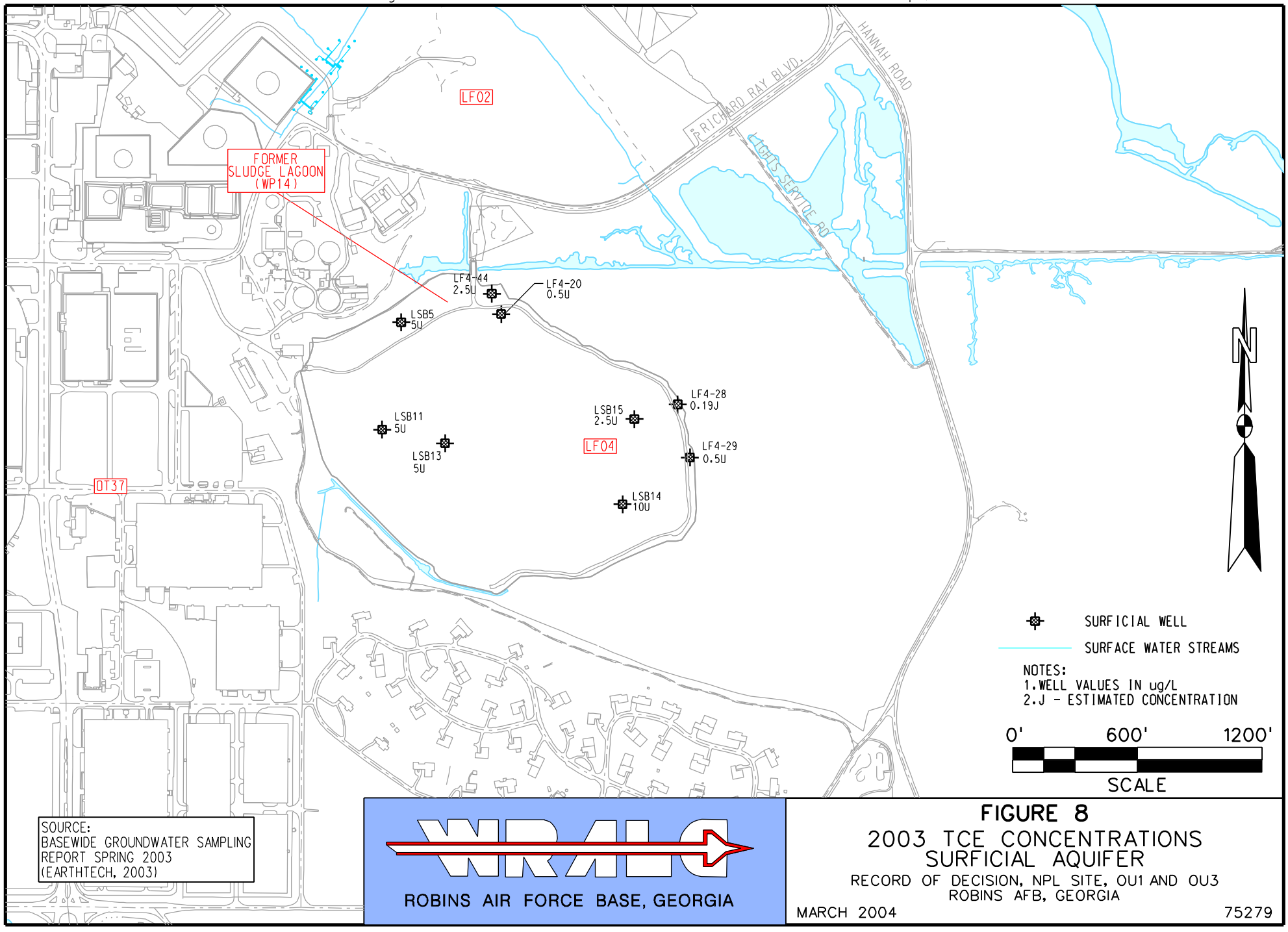

FIGURE 8
2003 TCE CONCENTRATIONS SURFICIAL AQUIFER

RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

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...\75279038.dgn DATE: 19 Apr, 2004 TIME: 1102

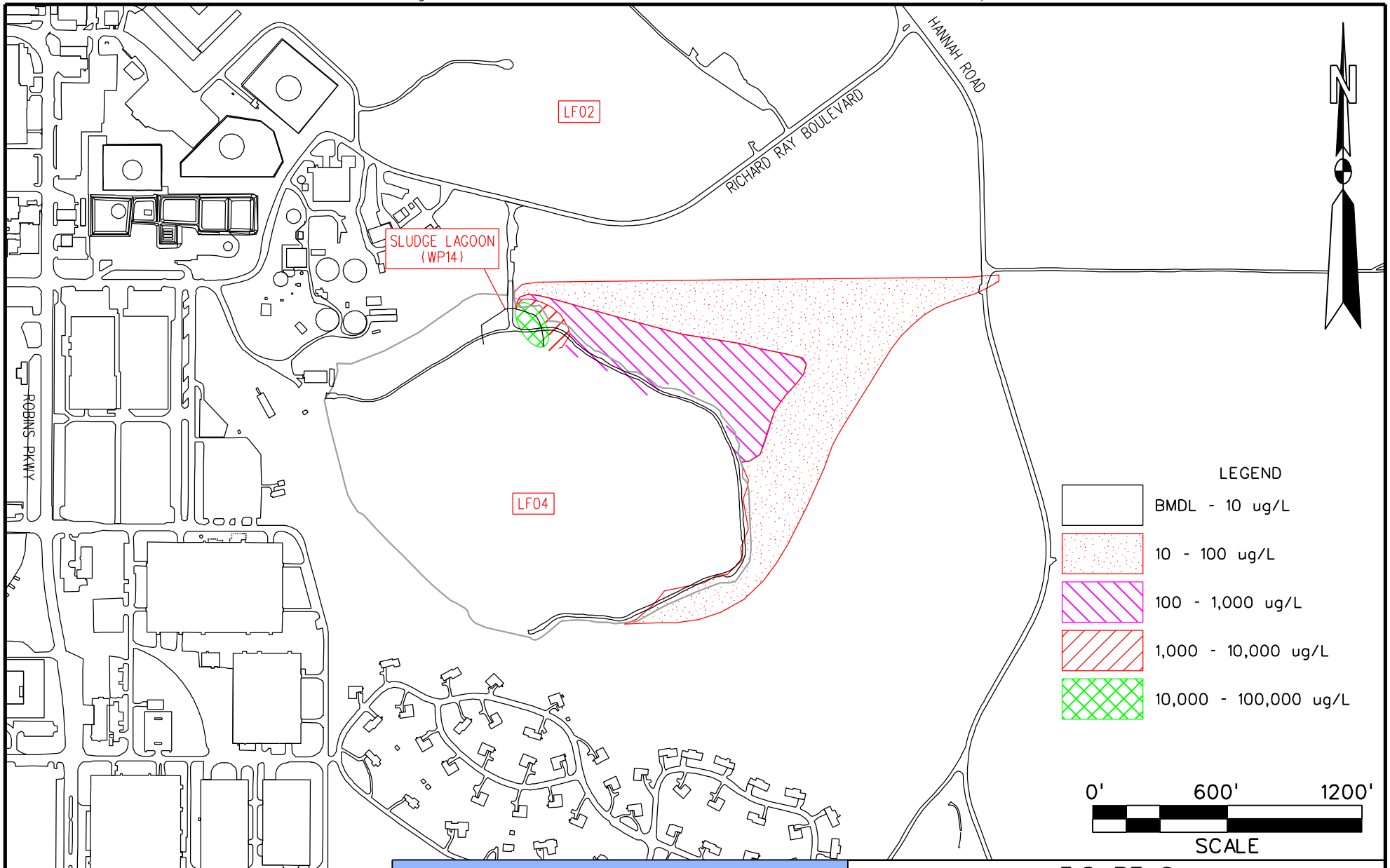

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FIGURE 9

1989 TCE CONCENTRATIONS QUATERNARY ALLUVIAL AQUIFER

RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

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...\75279040.dgn DATE: 19 Apr, 2004 TIME: 1103

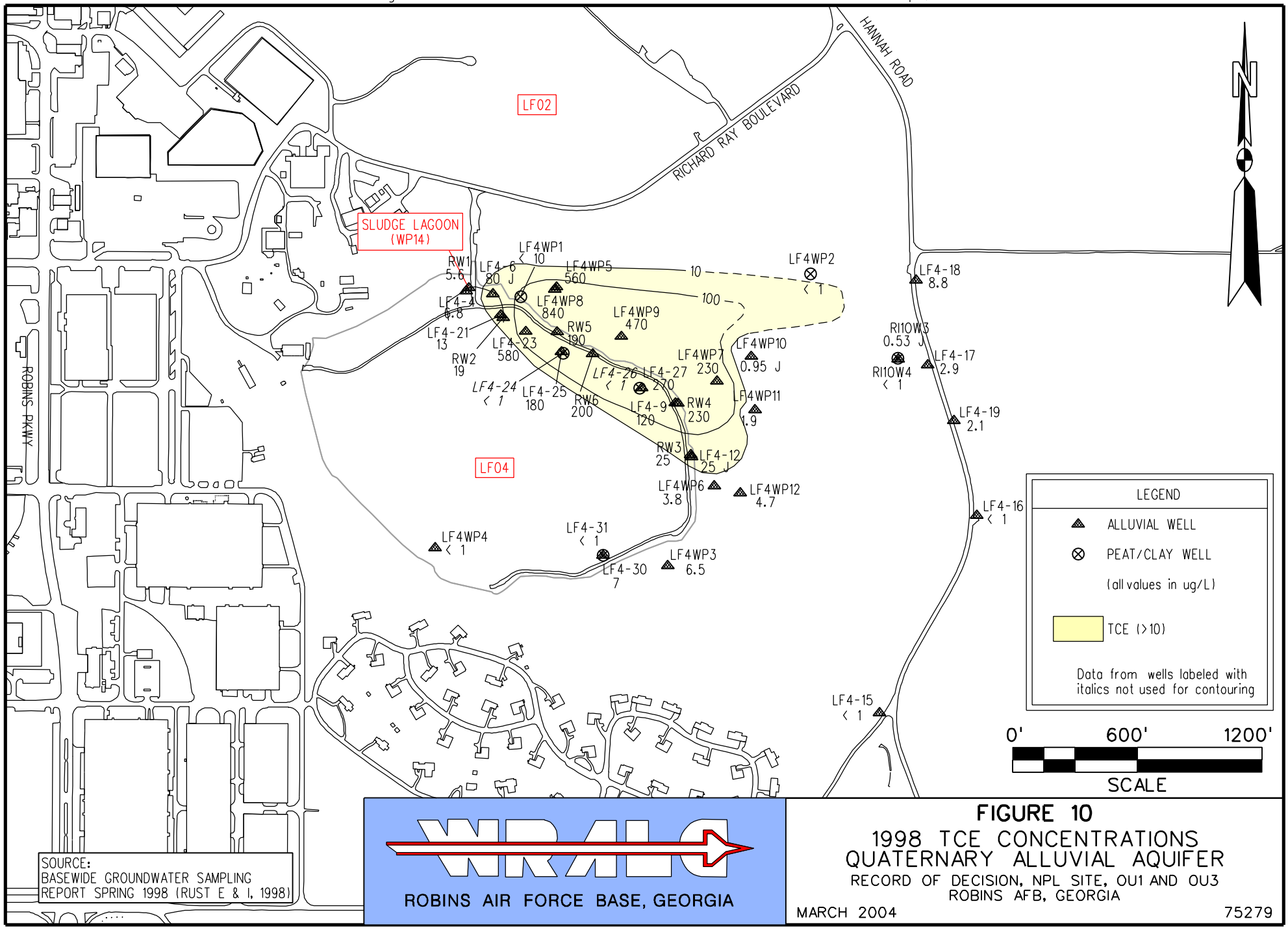

FIGURE 10
1998 TCE CONCENTRATIONS QUATERNARY ALLUVIAL AQUIFER
RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

MARCH 2004 75279

...\75279048.dgn DATE: 19 Apr, 2004 TIME: 1106

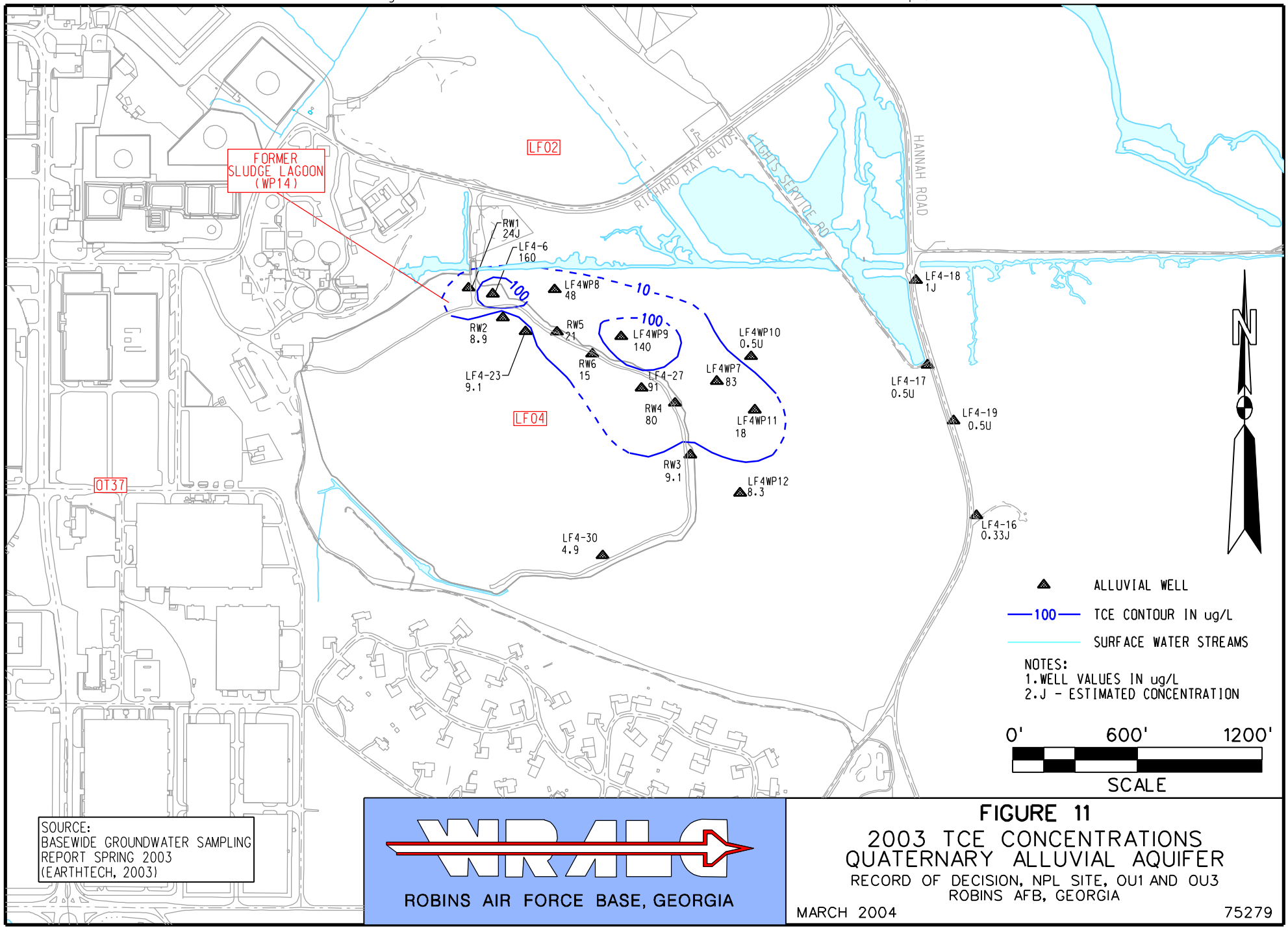

FIGURE 11

2003 TCE CONCENTRATIONS QUATERNARY ALLUVIAL AQUIFER

RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

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DATE: 13 Oct, 2004 TIME: 1140

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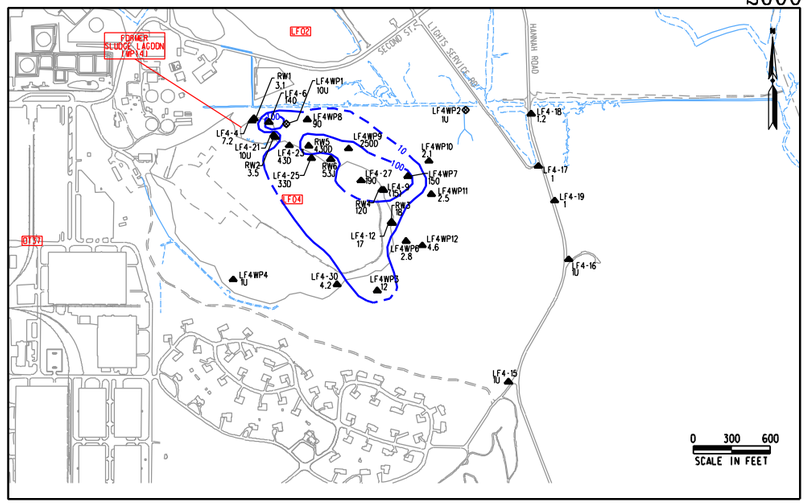
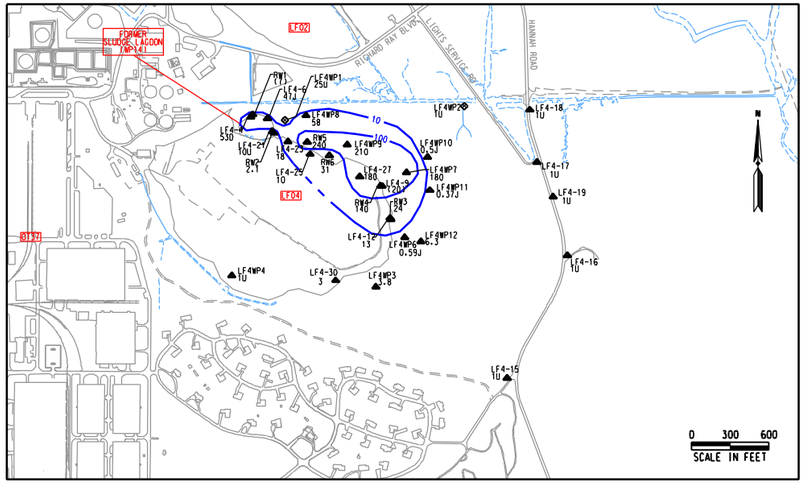
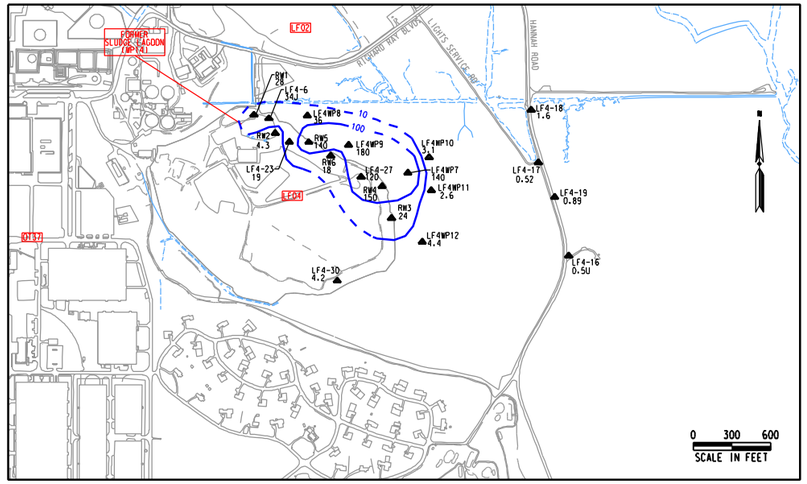
2000



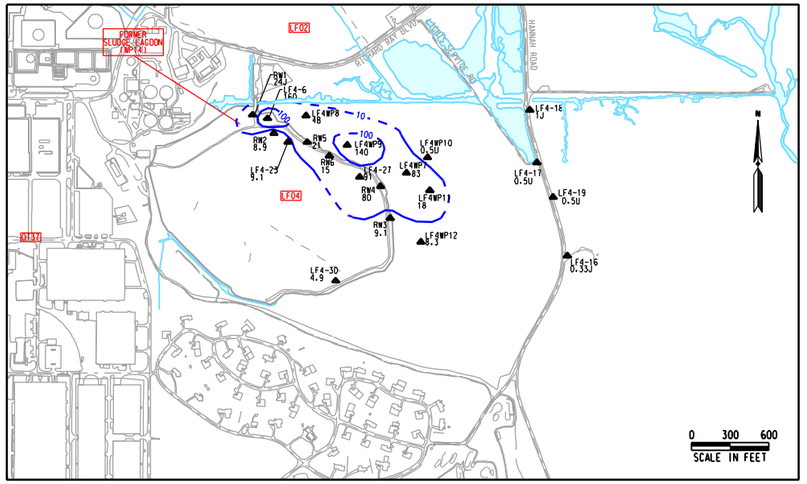
2001



2002



2003



LEGEND

- ALLUVIAL WELL
- PEAT/CLAY WELL
- 100 TCE CONTOUR IN ug/L
- SURFACE WATER STREAMS

NOTES:
1. WELL VALUES IN ug/L
2. DATA FROM WELLS LABELED IN PARENTHESIS WERE NOT USED FOR CONTOURING.
3. J - ESTIMATED CONCENTRATION
4. D - DILUTED SAMPLE

SOURCE:
BASEWIDE GROUNDWATER SAMPLING REPORT SPRING 2003 (EARTHTECH, 2003)

ROBINS AIR FORCE BASE, GEORGIA

FIGURE 12

HISTORICAL TCE CONCENTRATIONS QUATERNARY ALLUVIAL AQUIFER

RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

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...\75279041.dgn DATE: 19 Apr, 2004 TIME: 1104

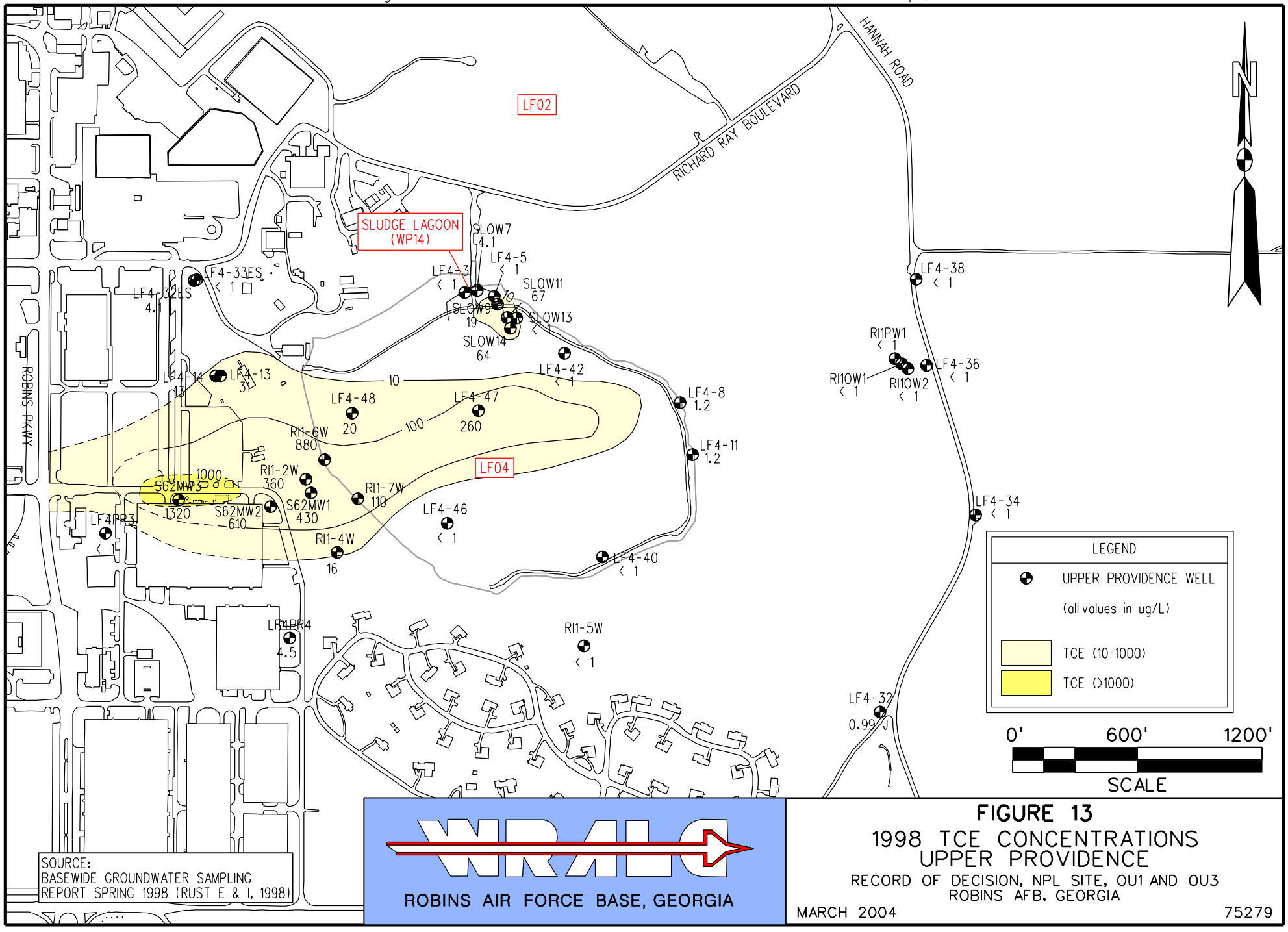

FIGURE 13

1998 TCE CONCENTRATIONS UPPER PROVIDENCE

RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

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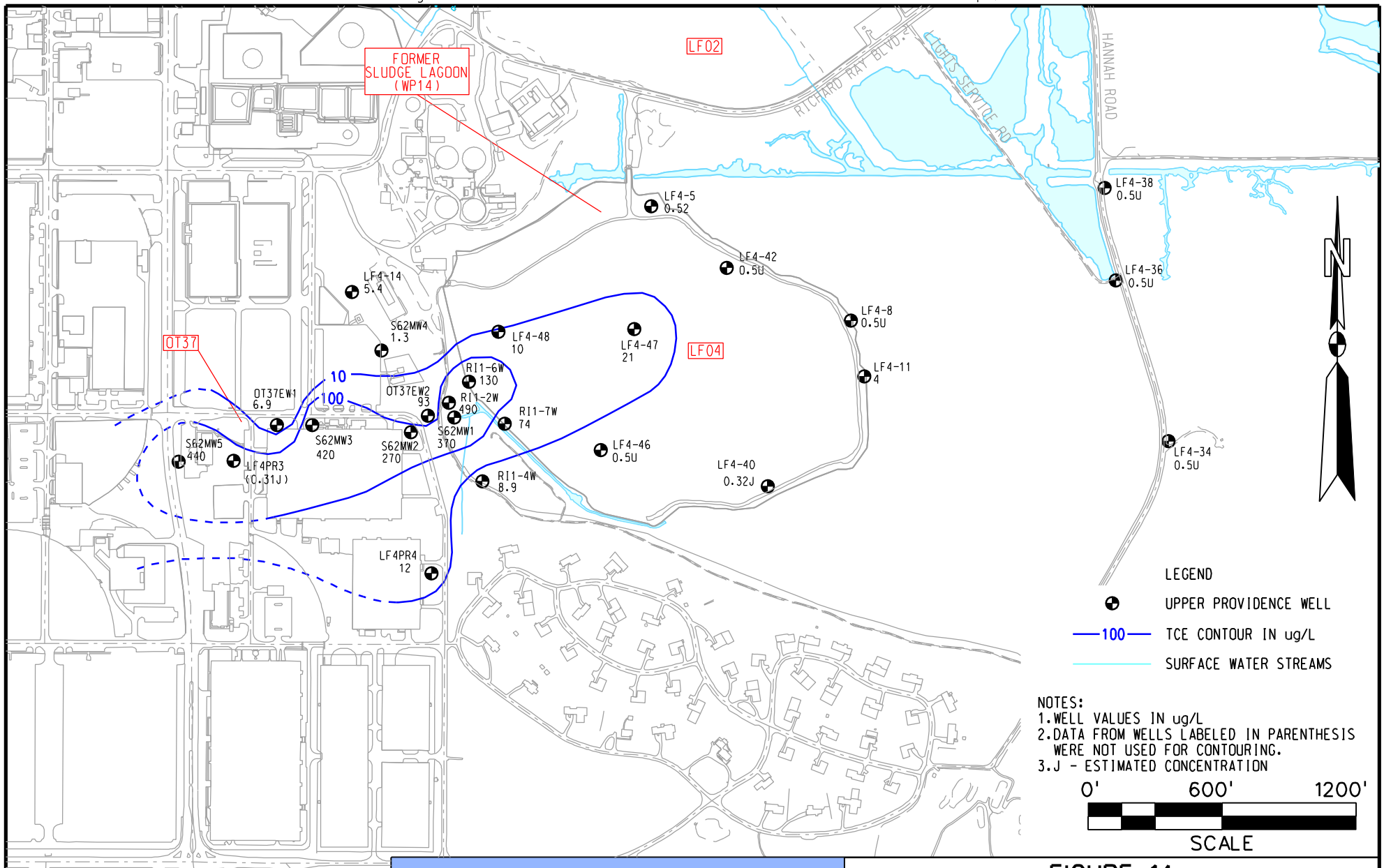
...\75279050.dgn DATE: 19 Apr, 2004 TIME: 1107



SOURCE:
BASEWIDE GROUNDWATER SAMPLING REPORT SPRING 2003 (EARTHTECH, 2003)

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FIGURE 14
2003 TCE CONCENTRATIONS UPPER PROVIDENCE
RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

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DATE: 13 Oct, 2004 TIME: 1140

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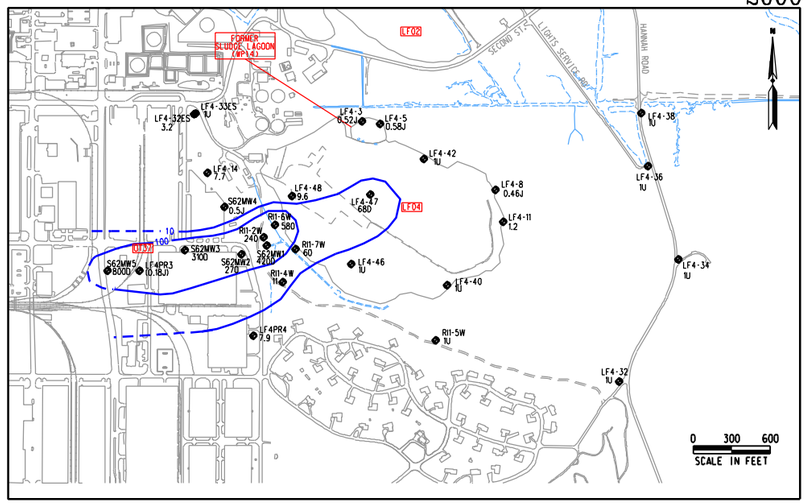
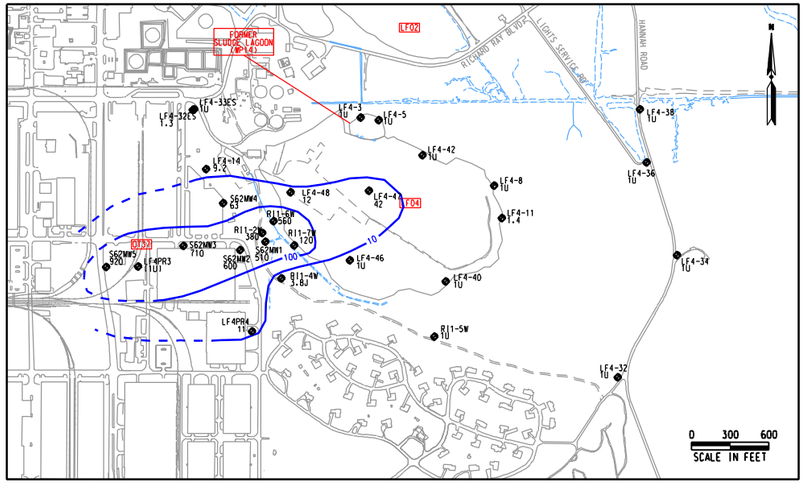
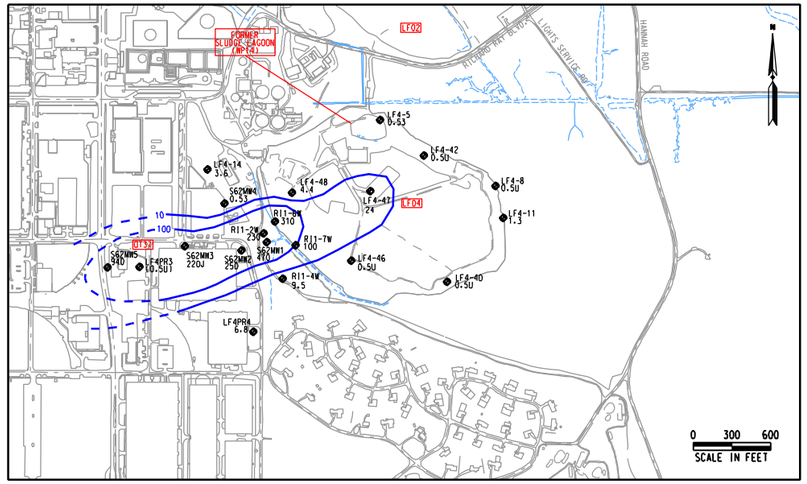
2000



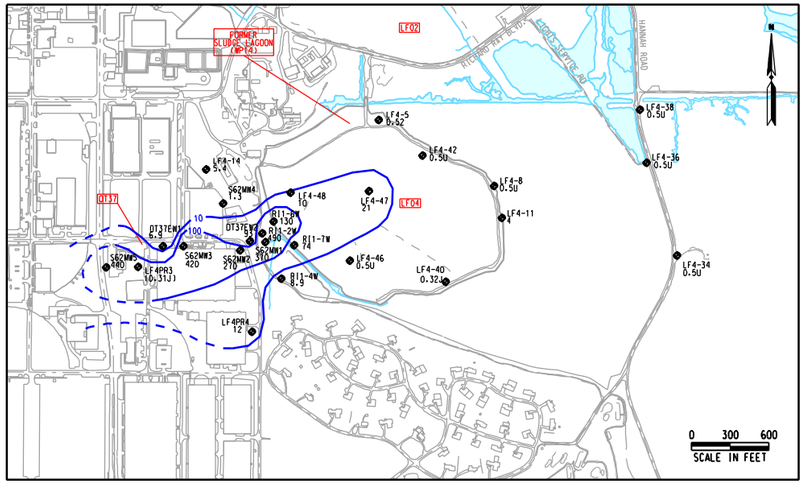
2001



2002



2003



UPPER PROVIDENCE WELL

100 TCE CONTOUR IN ug/L

SURFACE WATER STREAMS

NOTES:
1. WELL VALUES IN ug/L
2. DATA FROM WELLS LABELED IN PARENTHESIS WERE NOT USED FOR CONTOURING.
3. J - ESTIMATED CONCENTRATION
4. D - DILUTED SAMPLE

SOURCE:
BASEWIDE GROUNDWATER SAMPLING REPORT SPRING 2003 (EARTHTECH, 2003)

ROBINS AIR FORCE BASE, GEORGIA

FIGURE 15

HISTORICAL TCE CONCENTRATIONS UPPER PROVIDENCE

RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

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...\75279042.dgn DATE: 19 Apr, 2004 TIME: 1104

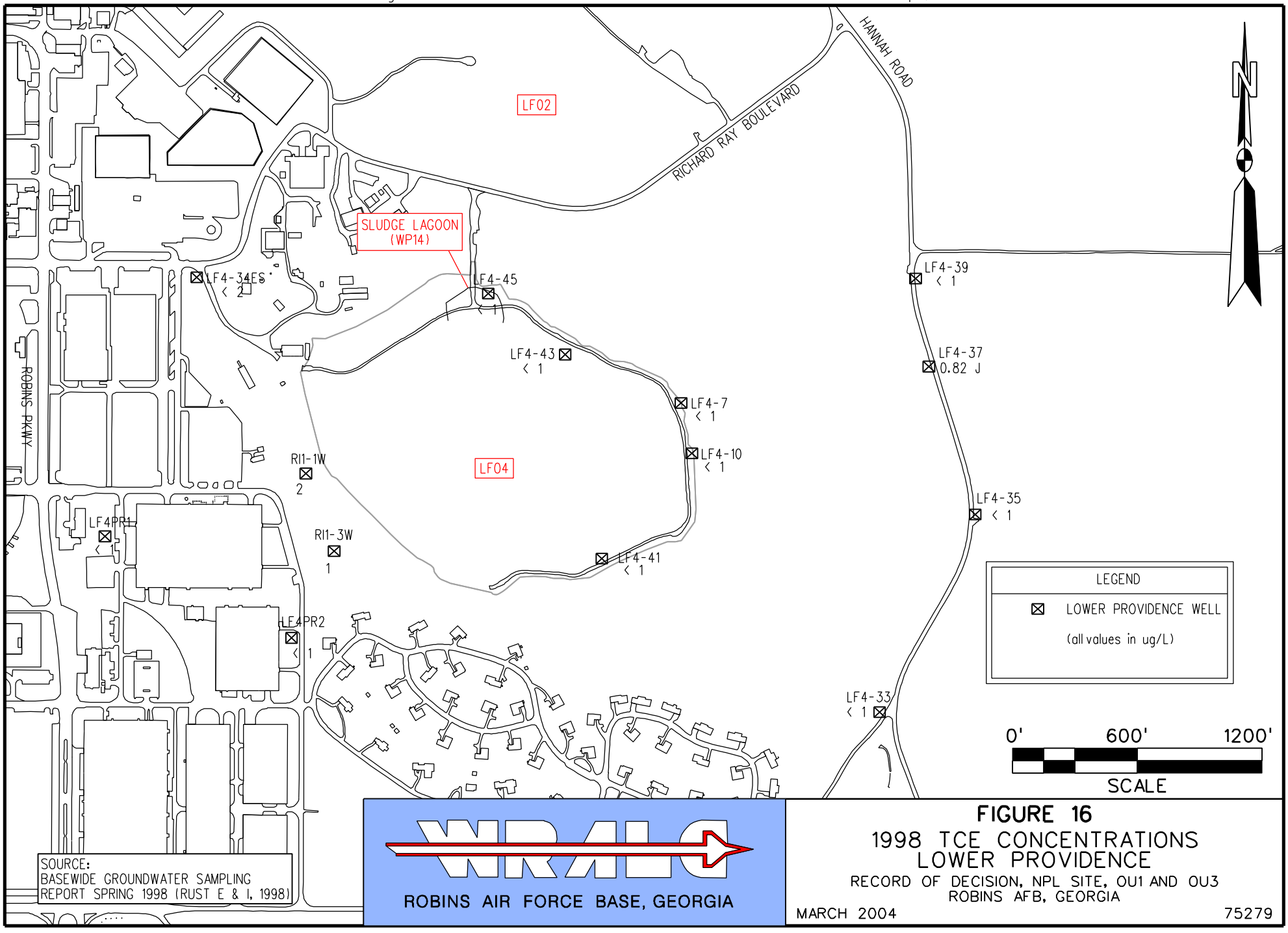

FIGURE 16

1998 TCE CONCENTRATIONS LOWER PROVIDENCE

RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

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...\75279051.dgn DATE: 19 Apr, 2004 TIME: 1107

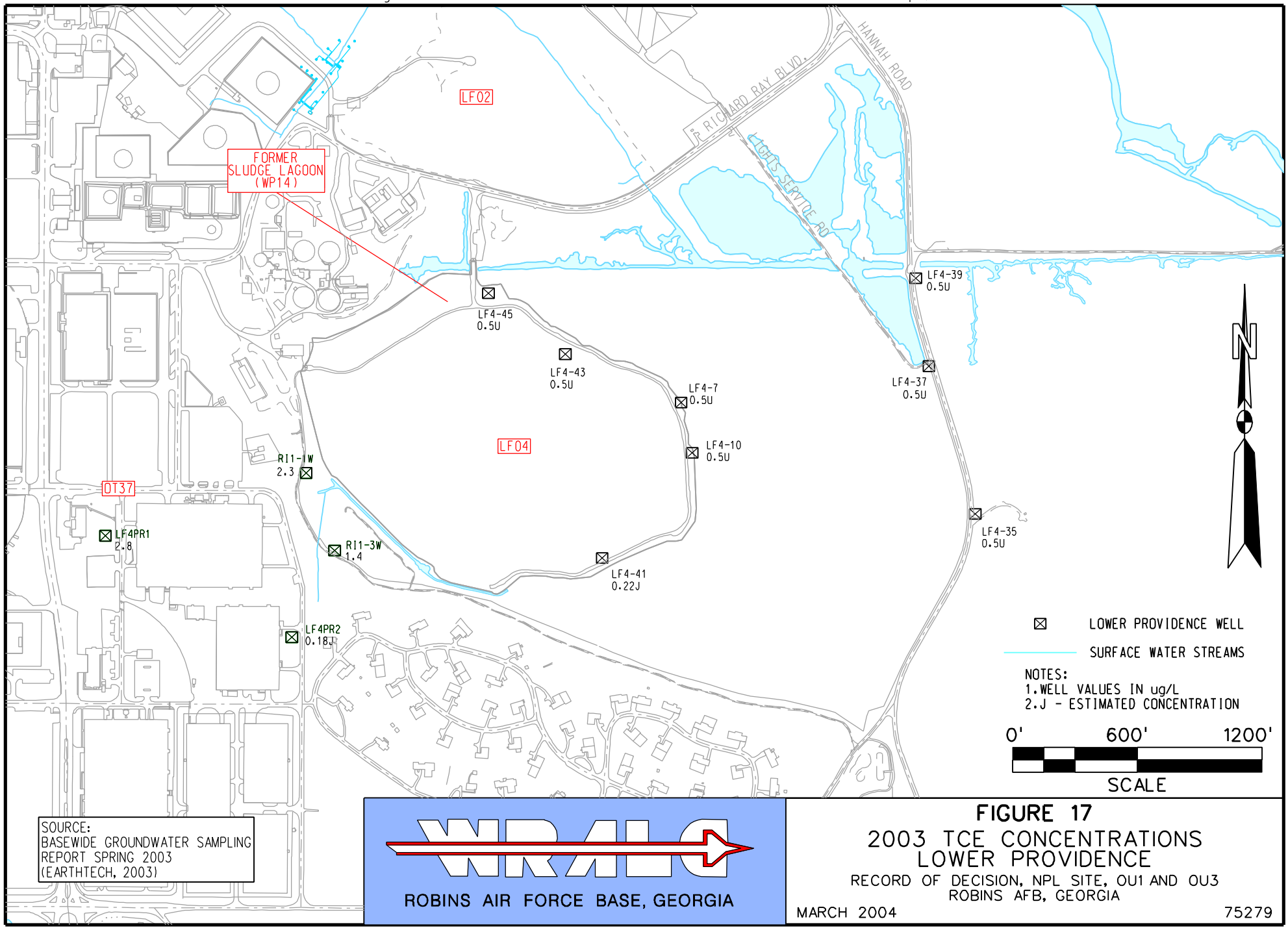

FIGURE 17
2003 TCE CONCENTRATIONS LOWER PROVIDENCE

RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

MARCH 2004 75279

...\75279044.dgn DATE: 19 Apr, 2004 TIME: 1105

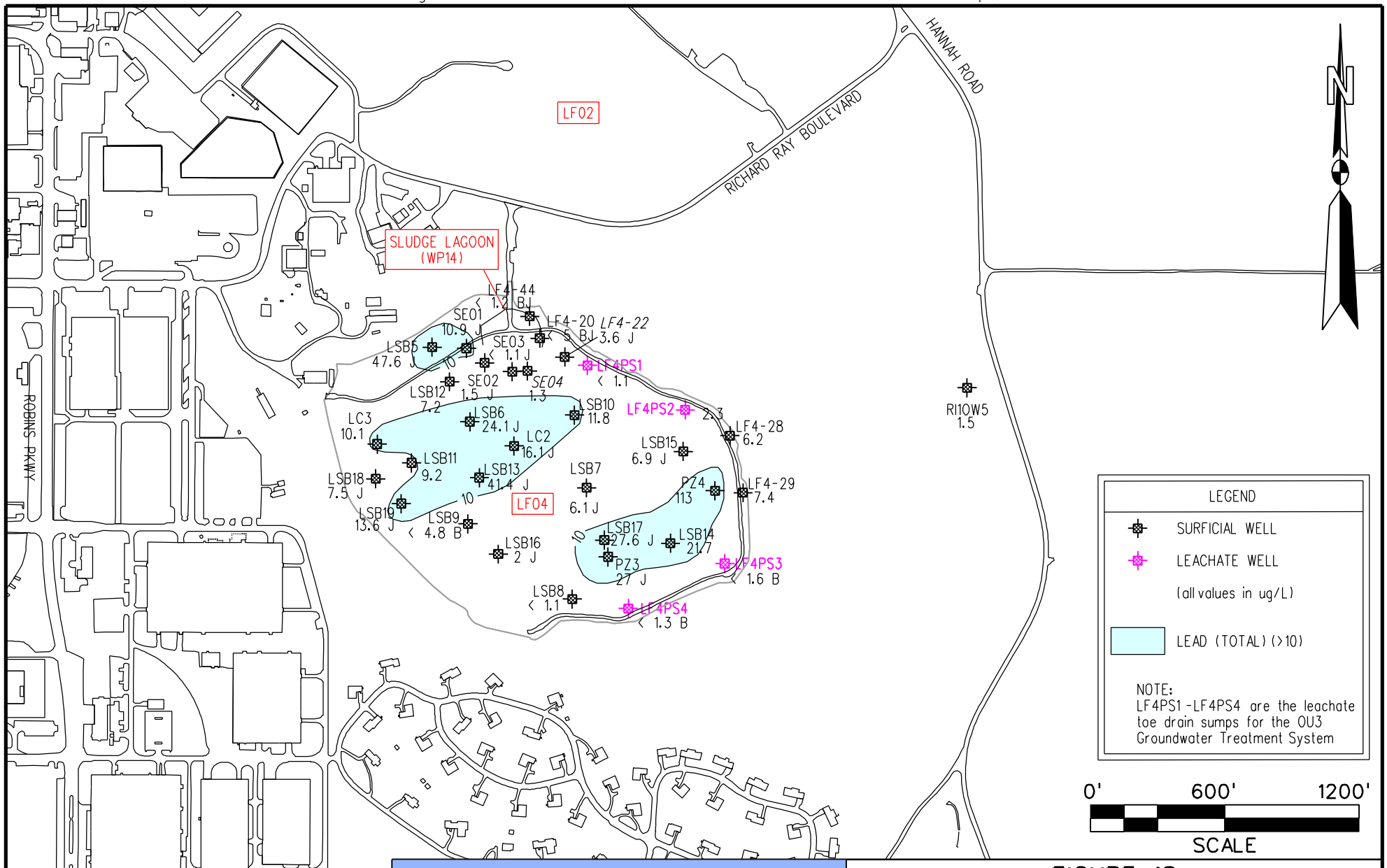

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FIGURE 18

1998 LEAD CONCENTRATIONS SURFICIAL AQUIFER

RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

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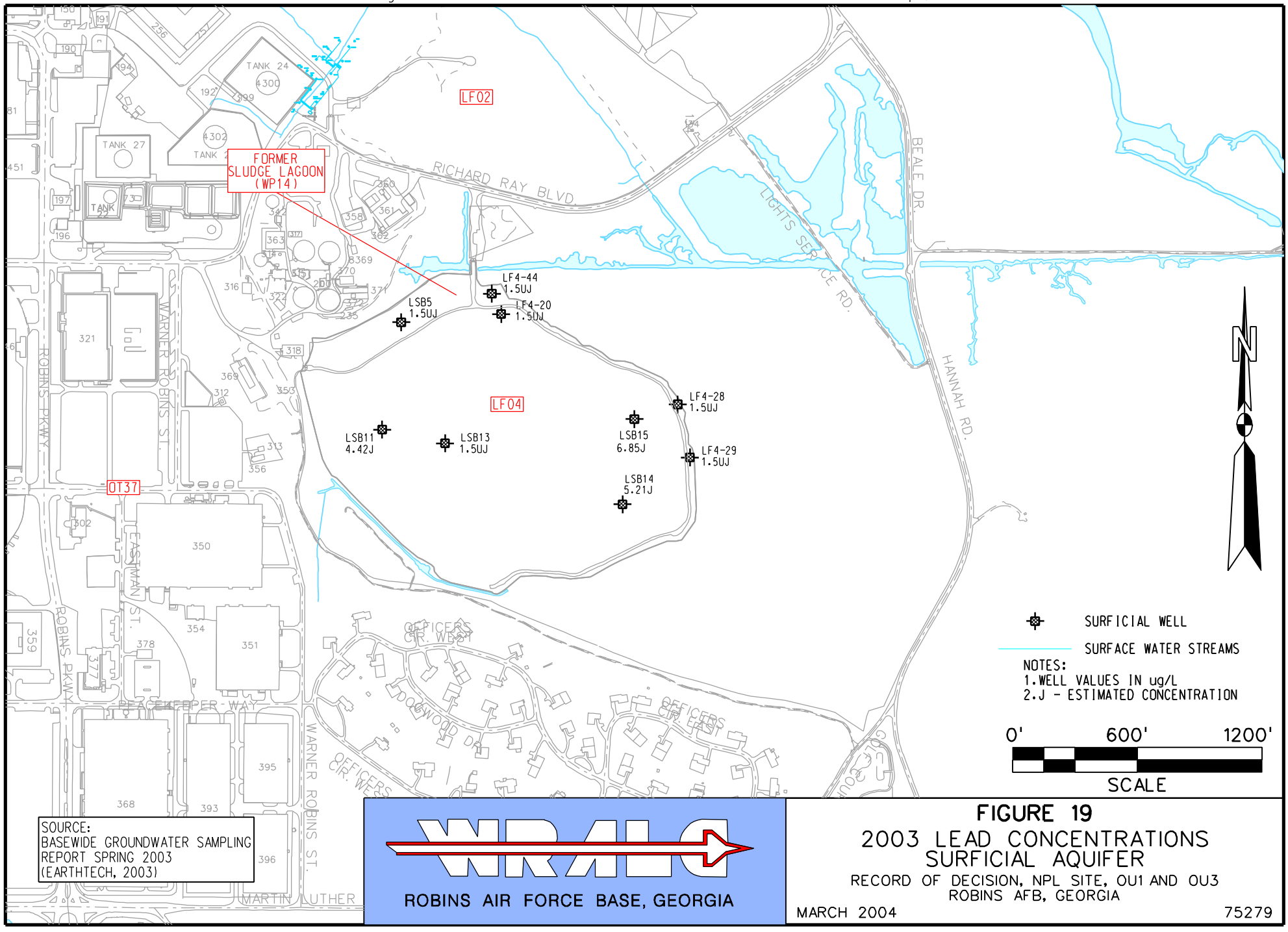
...\75279053.dgn DATE: 19 Apr, 2004 TIME: 1108



SOURCE:
BASEWIDE GROUNDWATER SAMPLING REPORT SPRING 2003 (EARTHTECH, 2003)

ROBINS AIR FORCE BASE, GEORGIA

FIGURE 19
2003 LEAD CONCENTRATIONS SURFICIAL AQUIFER

RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

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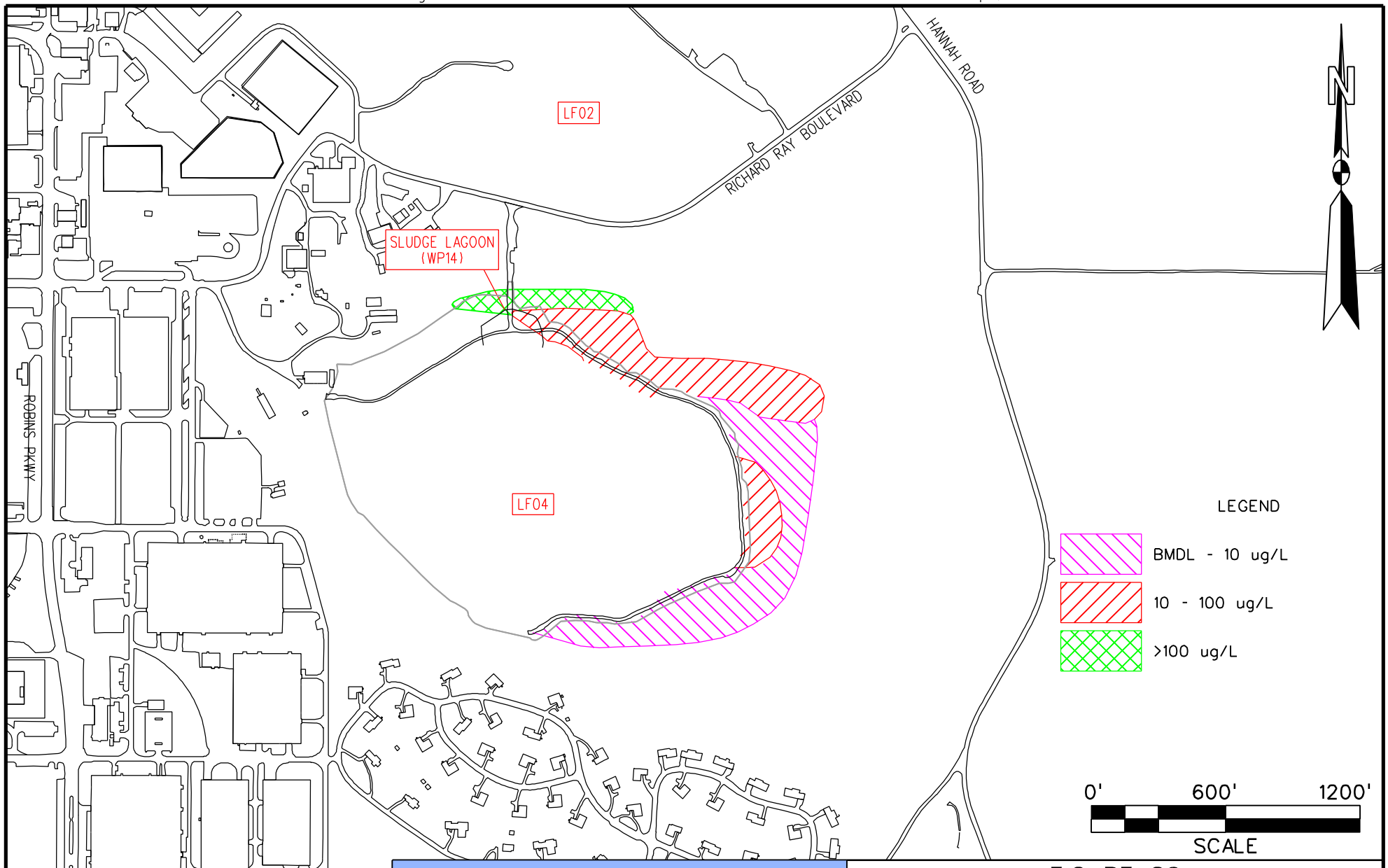
...\75279043.dgn DATE: 19 Apr, 2004 TIME: 1105



ROBINS AIR FORCE BASE, GEORGIA

FIGURE 20

1989 LEAD CONCENTRATIONS QUATERNARY ALLUVIAL AQUIFER

RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

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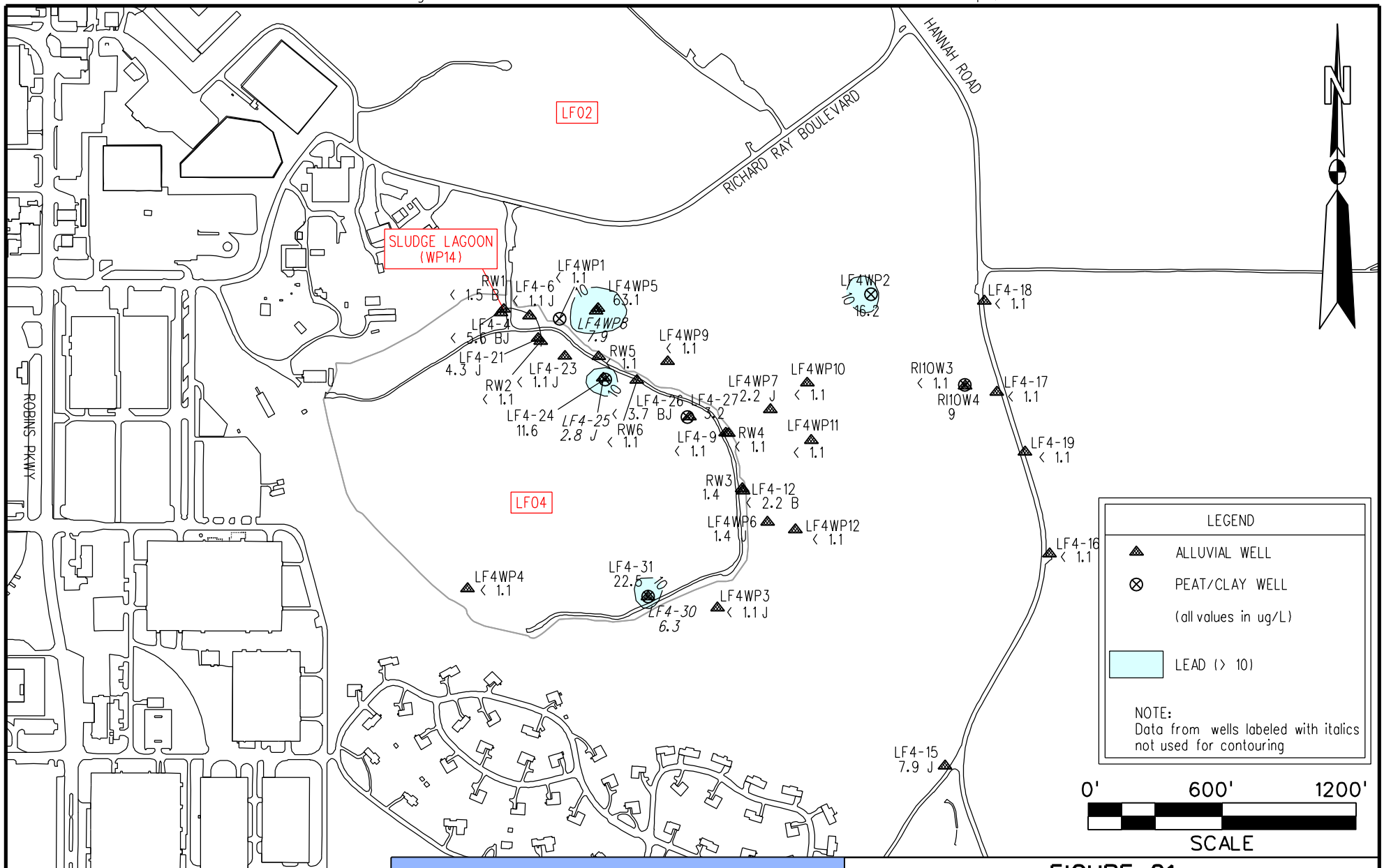
...\75279045.dgn DATE: 19 Apr, 2004 TIME: 1106



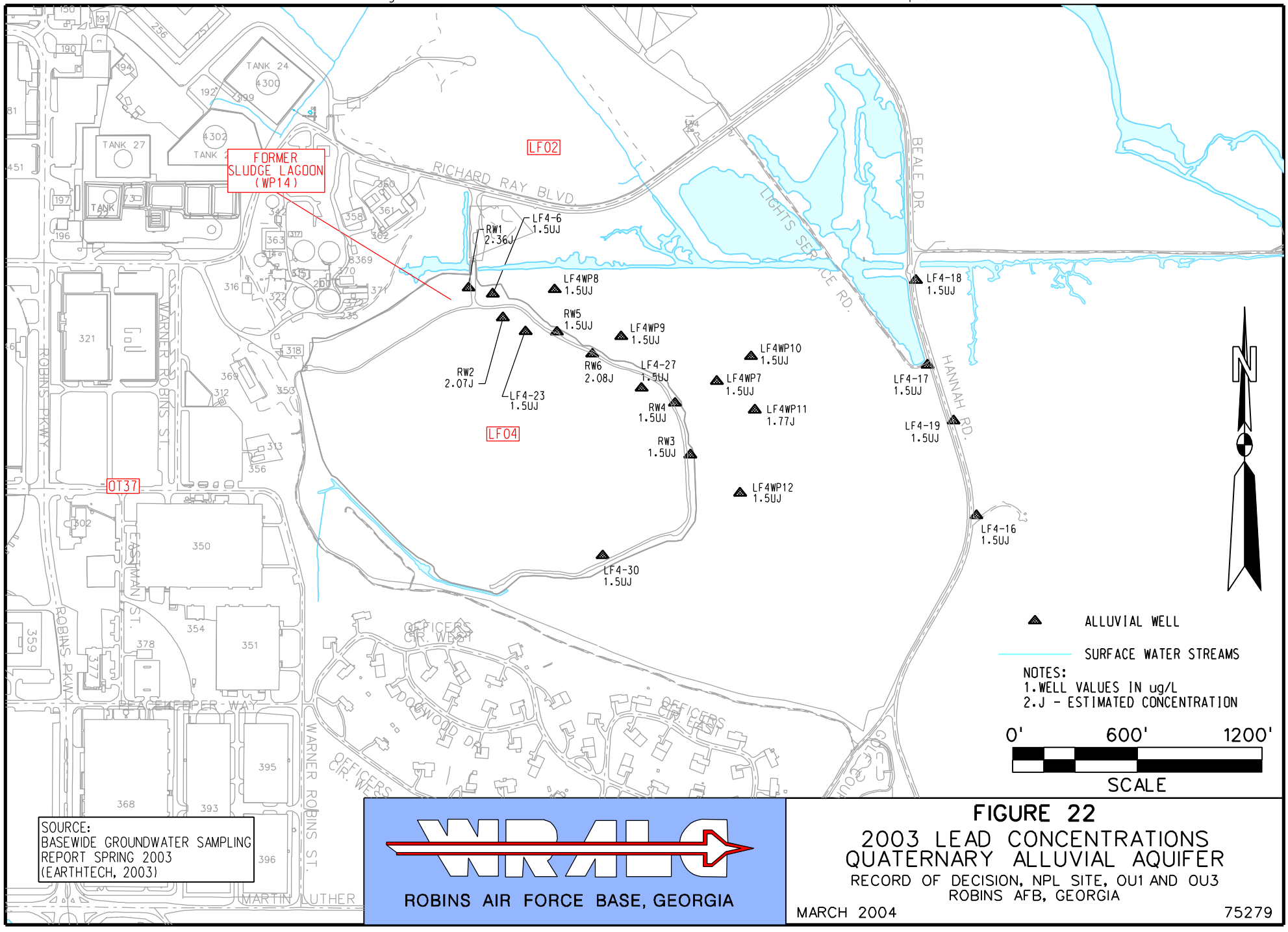
SOURCE:
BASEWIDE GROUNDWATER SAMPLING
REPORT SPRING 1998 (RUST E & I, 1998)

ROBINS AIR FORCE BASE, GEORGIA

FIGURE 21
1998 LEAD CONCENTRATIONS QUATERNARY ALLUVIAL AQUIFER
RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

MARCH 2004 75279

...\75279054.dgn DATE: 19 Apr, 2004 TIME: 1108



SOURCE:
BASEWIDE GROUNDWATER SAMPLING REPORT SPRING 2003 (EARTHTECH, 2003)

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FIGURE 22
2003 LEAD CONCENTRATIONS QUATERNARY ALLUVIAL AQUIFER
RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA

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NOTICE

ROBINS AFB IS OBLIGATED TO RESTRICT THE DISTURBANCE OF LANDFILL NO. 4 (LF04) AND THE WP14 SLUDGE LAGOON (OPERABLE UNIT NO.1 (OU1)) AND TO RESTRICT ACCESS TO IMPACTED GROUNDWATER (OPERABLE UNIT NO. 3 (OU3)), IN ACCORDANCE WITH THE RECORD OF DECISION FOR THE NATIONAL PRIORITIES LIST (NPL) SITE, OU1 AND OU3. THE GROUNDWATER CONTAMINATION ASSOCIATED WITH THE OPERABLE UNITS IS LOCATED DIRECTLY BENEATH AND TO THE EAST OF LF04. FILING OF THE SURVEY PLAT IS FOR NOTICE PURPOSES ONLY AND IS NOT INTENDED, NOR DOES IT CREATE, ANY INTEREST IN PROPERTY. THE U.S. CAN ONLY CONVEY OR DISPOSE OF PROPERTY INTERESTS IN ACCORDANCE WITH THE FEDERAL PROPERTY AND ADMINISTRATIVE SERVICES ACT OF 1949.

BOUNDARY DESCRIPTION

THE U.S. GEOLOGICAL SURVEY COORDINATES (LATITUDE/LONGITUDE) FOR THE APPROXIMATE CENTER OF LF04 ARE 32°37'09" NORTH AND 83°34'53" EAST. THE BOUNDARY LINE FOR LF04, AS DEPICTED ON THE DRAWING, WAS DERIVED FROM AS-BUILT DATA PROVIDED BY DONALDSON, GARRETT, AND ASSOCIATES, INC., AND DATA FROM THE ROBINS AIR FORCE BASE GEOGRAPHICAL INFORMATION SYSTEM. THE AS-BUILT DATA RESULTED FROM SEVERAL REMEDIATION PROJECTS, SPECIFICALLY THE LEACHATE COLLECTION SYSTEM PHASE II COMPLETED IN 1997, THE OU3 GROUNDWATER TREATMENT SYSTEM COMPLETED IN 1997, AND THE LF04 COVER RENOVATION COMPLETED IN 1998.

THE REVISED LF04 BOUNDARY BEGINS ON THE NORTH SIDE AT A CORNER POST OF THE NPL SITE PERIMETER FENCE ADJACENT TO THE GRAVEL ROAD APPROXIMATELY 20 FEET SOUTH OF THE CREEK. THE BOUNDARY CONTINUES EAST ACROSS THE GRAVEL ROAD TO A POINT APPROXIMATELY 10 FEET OUT FROM THE BOTTOM OF THE SLOPE OF THE ROAD AND THEN CONTINUES CLOCKWISE IN A SOUTHEASTERLY DIRECTION AROUND LF04 APPROXIMATELY 10 FEET OUT FROM THE LANDFILL SLOPE (TOPOGRAPHIC ELEVATION 250 FEET ABOVE MEAN SEA LEVEL) TO A POINT INTERSECTING THE NPL SITE PERIMETER FENCE AT THE TOP OF THE DIVERSION DITCH WESTERN SLOPE ON THE SOUTH SIDE OF LF04. THE BOUNDARY CONTINUES WEST ALONG THE FENCE LINE TO A POINT OF INTERSECTION WITH AN ACCESS ROAD FOR THE DIVERSION DITCH WEIR AND THEN RUNS ALONG THE ACCESS ROAD AND PARALLEL TO THE DIVERSION DITCH IN A NORTHWEST DIRECTION TO A POINT OF INTERSECTION WITH THE NPL SITE PERIMETER FENCE ON THE WEST SIDE OF LF04. IT THEN CONTINUES ALONG THE NPL SITE PERIMETER FENCE NORTH AND NORTHEAST BACK TO THE ORIGINATION POINT, THE CORNER POST OF THE NPL SITE PERIMETER FENCE ADJACENT TO THE GRAVEL ROAD.

LEGEND

- TREELINE
- WETLANDS AREA
- SURFACE WATER
- BASE PROVIDED CONTOUR INTERVAL LINE (2 TYPES)
- AS-BUILT CONTOUR INTERVAL LINE (2 TYPES)
- ROAD, IMPROVED, GRAVEL
- ROAD, IMPROVED, PAVED
- ROAD, DIRT OR UNIMPROVED
- CONCRETE
- NPL SITE PERIMETER FENCELINE
- LANDFILL NO. 04 BOUNDARY LINE
- WP14 IRP SITE
- UNDERDRAIN
- GAS VENT PIPING
- LANDFILL GAS VENTS
- CORRUGATED PLASTIC PIPE (CPP)
- FM FORCE MAIN, GROUNDWATER TREATMENT SYSTEM
- AIR RELIEF MANHOLE
- 48" REINFORCED CONCRETE PIPE JUNCTION BOX
- DROP INLET
- METER PIT
- RECOVERY WELL
- MONITORING WELL
- LEACHATE COLLECTION WELL
- LIGHT POLE
- ELECTRIC VAULT
- CONTROL PANEL
- APPROXIMATE CENTER OF LF04 FOR LATITUDE/LONGITUDE DATA

NOTE: GRID DEPICTED ON MAP IS DERIVED FROM THE NORTH AMERICAN DATUM 1983 (NAD83).

0' 120' 240'
SCALE

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FIGURE 23
LAND USE CONTROL AREA

RECORD OF DECISION, NPL SITE, OU1 AND OU3
ROBINS AFB, GEORGIA
MARCH 2004 75279

DATE: 28 Apr, 2004 TIME: 1025
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APPENDIX A

REVIEW OF INORGANIC CHEMICALS OF CONCERN (NICKEL AND CHROMIUM)

Review of Inorganic Chemicals of Concern

Table A-1 Historic Data for Chromium in Quaternary Alluvial Aquifer Monitoring locations for OU3

Table A-2 Historic Data for Chromium in Quaternary Alluvial Aquifer Monitoring Locations for OU3 Exceeding the MCL Historically

APPENDIX A

LIST OF ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirements
COC	Contaminants of Concern
MCL	Maximum Concentration Level
NPL	National Priorities List
OU3	Operable Unit 3
µg/L	Micrograms per Liter
US EPA	United States Environmental Protection Agency

INTRODUCTION

As presented in the *Feasibility Study Report* (Rust E&I, 1999a) and the *Draft Final Proposed Plan* (Rust E&I, 1999b) prepared for the National Priority List (NPL) site (Landfill number 4 and WP14 Sludge Lagoon), several inorganic parameters were identified as Chemicals of Concern (COCs) within both the Surficial aquifer and the Quaternary alluvial aquifer. A total of five inorganic parameters (arsenic, cadmium, chromium, lead, and nickel) were previously identified as COCs for the Operable Unit 3 (OU3) Surficial aquifer unit at the NPL site. In addition, one inorganic parameter (chromium) was identified as a COC for the Quaternary alluvial aquifer. Additional site-specific groundwater data and regulatory updates have become available since the initial designation of these inorganic parameters as COCs. Based upon a review of the more current and updated data discussed below, it is apparent that chromium should no longer be identified as a COC for the Quaternary alluvial aquifer. In addition, nickel should no longer be considered a COC for the Surficial aquifer at the NPL site due to the change in regulatory status as a drinking water contaminant.

Nickel in the Surficial Aquifer

The applicable or relevant and appropriate requirement (ARAR) established for nickel was the United States Environmental Protection Agency (US EPA) maximum contaminant level (MCL). The former US EPA MCL for nickel was 100 µg/L. This MCL was "remanded" on February 9, 1995 (US EPA, 2002). As of the most recent update to the US EPA National Primary Drinking Water Standards published in July 2003 (US EPA, 2003), there is no current MCL established for nickel. Because the former US EPA MCL for nickel has been "remanded", there is no effective ARAR for nickel at the NPL site. Therefore, nickel should be effectively removed as a COC in the Surficial aquifer at the NPL site.

Chromium in the Quaternary Alluvial Aquifer

Chromium was monitored in 27 Quaternary alluvial aquifer sampling locations during or before 1999. The measured concentrations exceeded the US EPA MCL (100 µg/L) in 10 of these monitoring locations on at least one occasion. Historic data collected between 1997 and 2003 for all 27 of these locations is presented in Table A-1. Data for only those monitoring locations that exceeded the US EPA MCL on at least one occasion are presented in Table A-2. As shown in Table A-2, the last sample to exceed the US EPA MCL was collected in 1999 (SLOW11, 139 µg/L). Six other locations (LF4-24, LF4-25, LF4-27,

LF4WP5, LF4WP6, and SLOW13) reported exceedances in 1997 and/or 1998, but not in 1999 or later. The three remaining locations (LF4-12, LF4WP7, and LF4WP8) have reported no exceedances since 1997.

Based on the data presented in Table A-2, it is clear that the concentrations of chromium in the Quaternary alluvial aquifer have declined to levels consistently below the US EPA MCL of 100 µg/L. Only one previous monitoring location (SLOW11) reported an exceedance in the most recently collected sample (June 4, 1999). SLOW11 has not been sampled since 1999 because it has been abandoned. The declining and consistently low concentrations reported in groundwater samples collected from the Quaternary Alluvial aquifer are strong indicators that chromium has been attenuated by natural processes (such as adsorption and dilution) and has effectively met the MCL (100 µg/L) at the NPL site. Because natural attenuation has occurred and 100% of the groundwater samples collected since the year 2000 have been below the ARAR (MCL of 100 µg/L), this parameter should no longer be identified as a COC within the Quaternary alluvial aquifer at the NPL site.

REFERENCES

US EPA, 2002, *Consumer Fact sheet on Nickel*, (November 2002).

US EPA, 2003, *US EPA National Primary Drinking Water Standards, Maximum Contaminant Levels,* EPA 816-F-03-016 (June 2003).

Table A-1
Historic Data for Chromium in Quaternary Alluvial Aquifer
Monitoring Locations for OU3
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Location	Date	Result (µg/L)
LF4-4	14-Mar-97	**1.5**
	24-Apr-98	**3.8**
	02-Jun-99	**0.8**
	22-May-00	<0.7
	07-May-01	**1.2**
LF4-6	14-Mar-97	**1.5**
	24-Apr-98	**1.9**
	02-Jun-99	**1.4**
	22-May-00	<0.7
	07-May-01	**1.6**
	03-May-02	**0.9**
	04-May-03	**1.31**
LF4-9	17-Mar-97	**1.2**
	25-Apr-98	**0.8**
	02-Jun-99	**0.6**
	18-May-00	**1.2**
	02-May-01	**8.0**
LF4-12	16-Mar-97	**3.2**
	26-Apr-98	<1.5
	08-Jun-99	**2.2**
	17-May-00	<0.7
	02-May-01	**17.8**
LF4-15	25-Mar-97	**17.6**
	28-Apr-98	**8.5**
	07-Jun-99	**1.1**
	18-May-00	<0.7
	02-May-01	**2.2**
LF4-16	24-Mar-97	**6.0**
	05-May-98	**7.1**
	02-Jun-99	**18.9**
	18-May-00	<0.7
	03-May-01	**1.3**
	01-May-02	**5.60**
	03-May-03	<0.8
LF4-17	24-Mar-97	**4.1**
	28-Apr-98	**20**
	06-Jun-99	**9.1**
	17-May-00	**1.0**
	03-May-01	**2.1**
	01-May-02	**2.60**
	06-May-03	**5.21**

Table A-1
Historic Data for Chromium in Quaternary Alluvial Aquifer
Monitoring Locations for OU3
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Location	Date	Result (µg/L)
LF4-18	25-Mar-97	<1.1
	04-May-98	**1.3**
	07-Jun-99	**0.7**
	17-May-00	<0.7
	03-May-01	<0.5
	02-May-02	<0.7
	05-May-03	<0.8
LF4-19	24-Mar-97	**7.3**
	05-May-98	**0.5**
	07-Jun-99	**0.7**
	17-May-00	<0.7
	02-May-01	<0.5
	02-May-02	<0.7
	07-May-03	**1.83**
LF4-21	17-Mar-97	<1.1
	27-Apr-98	**5.4**
	05-Jun-99	**5.1**
	18-May-00	**1.3**
	03-May-01	**22.0**
LF4-23	16-Mar-97	<1.1
	25-Apr-98	**1.7**
	04-Jun-99	**1.2**
	18-May-00	<0.7
	03-May-01	**1.1**
	02-May-02	<0.7
	05-May-03	<0.8
LF4-24	15-Mar-97	**91.4**
	25-Apr-98	**118**
	02-Jun-99	**15.9**
LF4-25	15-Mar-97	**19.1**
	28-Apr-98	**261**
	02-Jun-99	**0.5**
	18-May-00	<0.7
	03-May-01	**0.8**
LF4-26	17-Mar-97	**21.5**
	23-Apr-98	**24.1**
	07-Jun-99	**11.5**
LF4-27	16-Mar-97	**17.4**
	30-Apr-98	**143**
	07-Jun-99	**2.0**
	18-May-00	<0.7
	03-May-01	**3.2**
	02-May-02	<0.7
	02-May-03	**3.19**

Table A-1
Historic Data for Chromium in Quaternary Alluvial Aquifer
Monitoring Locations for OU3
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Location	Date	Result (µg/L)
LF4-30	17-Mar-97	<1.1
	04-May-98	**14.5**
	05-Jun-99	**1.0**
	18-May-00	<0.7
	03-May-01	**1.8**
	02-May-02	**1.20**
	05-May-03	**0.85**
LF4-31	17-Mar-97	**6.2**
	04-May-98	**3.7**
	05-Jun-99	**6.0**
LF4WP1	15-Mar-97	**50.7**
	27-Apr-98	**0.9**
	03-Jun-99	**1.2**
	19-May-00	**22.1**
	04-May-01	**4.4**
	03-May-02	**2.3**
	04-May-03	**2.31**
LF4WP2	25-Mar-97	**5.0**
	05-May-98	**6.9**
	07-Jun-99	**6.0**
	20-May-00	**3.8**
	04-May-01	**1.8**
	04-May-03	**4.84**
LF4WP3	18-Mar-97	**9.6**
	26-Apr-98	**2.6**
	07-Jun-99	**21.1**
	20-May-00	**3.9**
	04-May-01	**2.1**
LF4WP4	18-Mar-97	**3.3**
	25-Apr-98	**2.2**
	04-Jun-99	**8.0**
	19-May-00	**54.8**
	04-May-01	**15.6**
LF4WP5	15-Mar-97	**761**
	26-Apr-98	**10.1**
	04-Jun-99	**6.0**
LF4WP6	17-Mar-97	**2140**
	27-Apr-98	**316**
	05-Jun-99	**42.9**
	20-May-00	**16.0**
	04-May-01	**90.3**

Table A-1
Historic Data for Chromium in Quaternary Alluvial Aquifer
Monitoring Locations for OU3
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Location	Date	Result (µg/L)
LF4WP7	18-Mar-97	**25.2**
	28-Apr-98	**1.7**
	06-Jun-99	**5.0**
	20-May-00	<0.7
	04-May-01	**2.1**
	02-May-02	**5.20**
	04-May-03	**1.23**
LF4WP8	15-Mar-97	**3.8**
	25-Apr-98	**6.0**
	03-Jun-99	**2.8**
	20-May-00	**2.2**
	05-May-01	**2.0**
	03-May-02	**2.89**
	03-May-03	**4.47**
LF4WP9	16-Mar-97	**3.5**
	27-Apr-98	**2.6**
	04-Jun-99	**2.6**
	20-May-00	**1.2**
	05-May-01	<0.5
	03-May-02	**2.58**
	05-May-03	**2.25**
LF4WP10	18-Mar-97	**2.4**
	27-Apr-98	**0.9**
	06-Jun-99	**1.5**
	21-May-00	**0.8**
	06-May-01	<0.5
	02-May-02	**3.64**
	05-May-03	**3.78**
LF4WP11	18-Mar-97	**2.1**
	05-May-98	**1**
	06-Jun-99	**1.8**
	21-May-00	**1.1**
	06-May-01	<0.5
	02-May-02	<0.7
	05-May-03	**10.9**
LF4WP12	18-Mar-97	**2.8**
	05-May-98	<0.3
	06-Jun-99	**14.7**
	19-May-00	**2.3**
	04-May-01	**3.0**
	03-May-02	**8.37**
	02-May-03	**4.5**
RI1OW3	26-Mar-97	**1.5**
	04-May-98	<0.3
	08-Jun-99	**0.4**

Table A-1
Historic Data for Chromium in Quaternary Alluvial Aquifer
Monitoring Locations for OU3
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Location	Date	Result (µg/L)
RI1OW4	26-Mar-97	**15.7**
	06-May-98	**1.4**
	08-Jun-99	**4.0**
RW1	13-Mar-97	**1.3**
	22-Oct-97	<10
	07-Jan-98	<10
	06-May-98	**0.6**
	06-Aug-98	<10
	11-Nov-98	<10
	08-Mar-99	<10
	06-May-99	**1.8**
	07-Feb-00	<10
	21-May-00	**1.1**
	05-May-01	<0.5
	02-May-02	<10
	01-May-03	**1.21**
RW2	16-Mar-97	**2.9**
	22-Oct-97	<10
	07-Jan-98	<10
	06-May-98	**1.3**
	06-Aug-98	<10
	11-Nov-98	<10
	08-Mar-99	<10
	06-May-99	**1.7**
	07-Feb-00	<10
	22-May-00	<0.7
	04-May-01	<0.5
	02-May-02	**1.65**
	01-May-03	<0.8
RW3	15-Mar-97	**2.3**
	22-Oct-97	<10
	07-Jan-98	<10
	06-May-98	**0.5**
	06-Aug-98	<10
	11-Nov-98	<10
	08-Mar-99	<10
	06-May-99	**1.6**
	07-Feb-00	<10
	20-May-00	<0.7
	06-May-01	<0.5
	01-May-02	**0.8**
	01-May-03	**1.74**

Table A-1
Historic Data for Chromium in Quaternary Alluvial Aquifer
Monitoring Locations for OU3
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Location	Date	Result (µg/L)
RW4	15-Mar-97	**9.6**
	22-Oct-97	<10
	07-Jan-98	<10
	06-May-98	**1.8**
	06-Aug-98	<10
	11-Nov-98	<10
	08-Mar-99	<10
	06-May-99	**1.5**
	07-Feb-00	<10
	20-May-00	<0.7
	06-May-01	<0.5
	01-May-02	<0.7
	01-May-03	<0.8
RW5	16-Mar-97	**1.4**
	22-Oct-97	<10
	07-Jan-98	<10
	06-May-98	**0.3**
	06-Aug-98	<10
	11-Nov-98	<10
	08-Mar-99	<10
	06-May-99	**1.6**
	07-Feb-00	<10
	20-May-00	<0.7
	06-May-01	**0.8**
	03-May-02	**0.99**
	01-May-03	<0.8
RW6	17-Mar-97	<1.1
	22-Oct-97	<10
	07-Jan-98	<10
	06-May-98	<0.3
	06-Aug-98	<10
	11-Nov-98	<10
	08-Mar-99	<10
	06-May-99	**0.4**
	07-Feb-00	<10
	20-May-00	<0.7
	06-May-01	**0.7**
	03-May-02	**0.92**
	01-May-03	**0.94**

Table A-1
Historic Data for Chromium in Quaternary Alluvial Aquifer
Monitoring Locations for OU3
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Location	Date	Result (µg/L)
SLOW7	14-Mar-97	<1.1
	24-Apr-98	**4.1**
	02-Jun-99	**0.3**
SLOW9	15-Mar-97	**2.9**
	25-Apr-98	<1.7
	04-Jun-99	**1.4**
SLOW11	15-Mar-97	**1.5**
	25-Apr-98	<2.4
	04-Jun-99	**139**
SLOW13	25-Mar-97	**2230**
	07-May-98	**7.9**
	07-Jun-99	**2.1**
SLOW14	15-Mar-97	**8.0**
	25-Apr-98	**3.1**
	03-Jun-99	**0.3**

Notes:

1) Chromium Maximum Contaminant Level = 100 µg/L; US EPA National Primary Drinking Water Standards, EPA 816-F-03-016 (US EPA, June 2003).
2) All Monitoring Locations Sampled since 1997.
3) Bolded values indicate detections.
4) Shaded areas indicate concentrations exceeding MCL.

Table A-2
Historic Data for Chromium in Quaternary Alluvial Aquifer Monitoring Locations for OU3 Exceeding the MCL Historically
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Location	Currently Monitored	Date	Result (µg/L)
LF4-12	No	16-Mar-97	**3.2**
		26-Apr-98	<1.5
		08-Jun-99	**2.2**
		17-May-00	<0.7
		02-May-01	**17.8**
LF4-24	No	15-Mar-97	**91.4**
		25-Apr-98	**118**
		02-Jun-99	**15.9**
LF4-25	No	15-Mar-97	**19.1**
		28-Apr-98	**261**
		02-Jun-99	**0.5**
		18-May-00	<0.7
		03-May-01	**0.8**
LF4-27	Yes	16-Mar-97	**17.4**
		30-Apr-98	**143**
		07-Jun-99	**2.0**
		18-May-00	<0.7
		03-May-01	**3.2**
		02-May-02	<0.7
		02-May-03	**3.19**
LF4WP5	No	15-Mar-97	**761**
		26-Apr-98	**10.1**
		04-Jun-99	**6.0**
LF4WP6	No	17-Mar-97	**2140**
		27-Apr-98	**316**
		05-Jun-99	**42.9**
		20-May-00	**16.0**
		04-May-01	**90.3**
LF4WP7	Yes	18-Mar-97	**25.2**
		28-Apr-98	**1.7**
		06-Jun-99	**5.0**
		20-May-00	<0.7
		04-May-01	**2.1**
		02-May-02	**5.20**
		04-May-03	**1.23**
LF4WP8	Yes	15-Mar-97	**3.8**
		25-Apr-98	**6.0**
		03-Jun-99	**2.8**
		20-May-00	**2.2**
		05-May-01	**2.0**
		03-May-02	**2.89**
		03-May-03	**4.47**

Table A-2
Historic Data for Chromium in Quaternary Alluvial Aquifer Monitoring Locations for OU3 Exceeding the MCL Historically
Record of Decision for the NPL Site, Operable Units (OUs) 1 and 3
Robins AFB, Georgia

Location	Currently Monitored	Date	Result (µg/L)
SLOW11	Abandoned	15-Mar-97	**1.5**
		25-Apr-98	<2.4
		04-Jun-99	**139**
SLOW13	Abandoned	25-Mar-97	**2230**
		07-May-98	**7.9**
		07-Jun-99	**2.1**

Notes:

1) Chromium Maximum Contaminant Level (MCL) = 100 µg/L; US EPA National Primary Drinking Water Standards, EPA 816-F-03-016 (US EPA, June 2003).

2) Bolded values indicate detections.

3) Shaded areas indicate concentrations exceeding MCL.